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SEPTEMBER, 1933

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H. C. PARMELEE, Editorial Director

Editorial Staff:
NEW YORK
A. H. HUBBELL
H. D. KEISER
W. N. P. REED
H. H. WANDERS

LONDON
Aldwych House, Aldwych W.C. 2
A. W. ALLEN

Editorial Staff:
SAN FRANCISCO
883 Mission St.
J. B. HUTTL
G. J. YOUNG
Consultant

WASHINGTON, D. C.
National Press Building
PAUL WOOTON

H. W. CLARKE
Publishing Director

CONTENTS FOR SEPTEMBER 1933

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VOLUME 134 NUMBER 9

Editorials 357

Non-ferrous Metal Codes Pour Into Washington 359

Chemical Migration—Post-Mine Phenomena in New Guinea
Roland Blanchard 365

Equipping for Hand Tramming ..... *Lucien Eaton* 369

Scrap and the Lead Market ..... *Samuel Tzach* 371

Powder Metallurgy ..... *Charles Hardy* 373

Mining Asbestos in U.S.S.R. ..... *W. A. RuKeyser* 375

Flotation on Mother Lode—Idaho-Maryland Solves Difficult Problem
E. W. Ellis 382

An Efficient and Economical Crushed-Stone Plant
Sir Robert Hadfield, Bart. 384

Trends and Developments in the Industry ... 386
Personal Notes, Comment, Criticism 393
Book Reviews 395
Industrial Progress 396
Market Data 399

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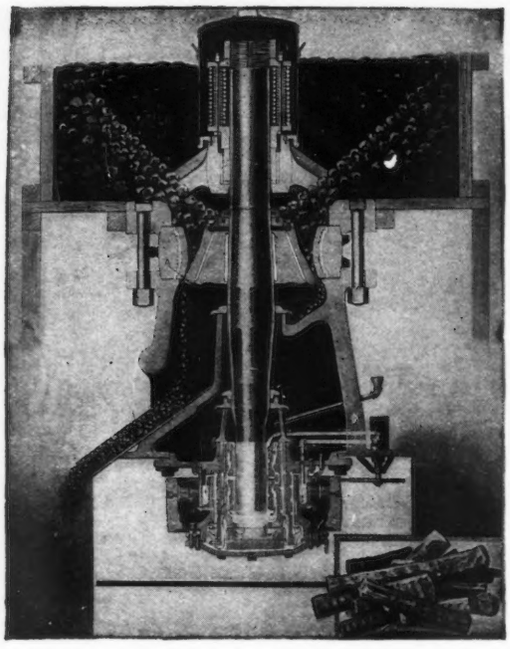

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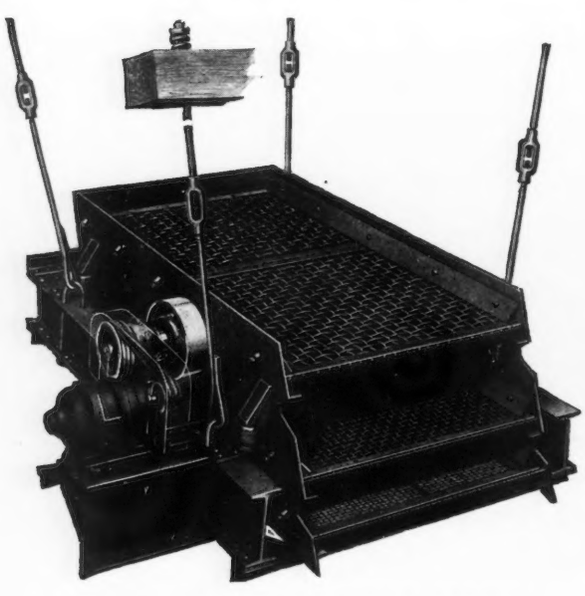

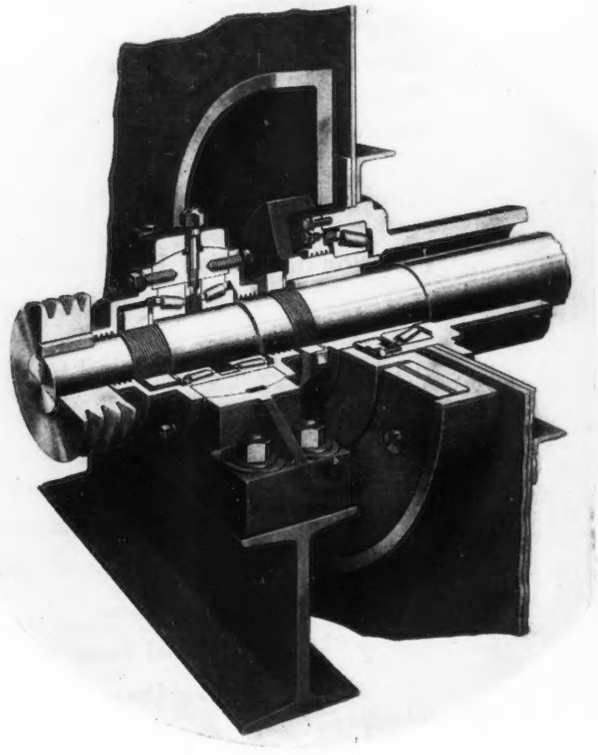

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Engineering and Mining Journal

WITH WHICH IS CONSOLIDATED
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H. C. PARMELEE, *Editorial Director*

SEPTEMBER, 1933

Newly Mined Gold May Be Exported

EVENTS HAVE MOVED swiftly during the past month in the campaign of domestic gold producers for a world market for their product. One by one concessions have been made by the Government, relaxing the restrictions of the embargo, but leaving producers uncertain as to their rights or the best procedure in dealing with foreign agencies. Small producers in particular have been in a quandary. At last, however, pressure on the Government for more generous and definite consideration has resulted in executive action.

On August 29 the President issued an order authorizing the Secretary of the Treasury and Federal Reserve banks to receive on consignment for sale, "gold recovered from natural deposits in the United States." Sales may be made by export to foreign purchasers at a price which the Secretary shall determine to be equal to the best price obtainable in the free gold markets of the world, less the expense of shipping and insurance. Shippers must agree, however, to accept as final and conclusive the determination of the Secretary as to the net amount due them from the sale of their product.

This action by the President can only be regarded as one more step toward the inevitable removal of all restrictions on the sale of newly mined gold. The producer is still hedged about by some restrictions, though his position is more favorable than under the regulations which permitted only the export of unrefined gold. At least he can save refining charges, which would have reduced the premium over the domestic price, and he can deal with a domestic rather than a foreign sales agency. Short of a complete raising of the embargo, this is probably the best arrangement that can be made. It should materially increase the income of gold producers.

Non-Ferrous Metal Codes Submitted

CODES OF FAIR COMPETITION for the principal non-ferrous metal mining, smelting and refining industries have been submitted to the NRA and will soon be scheduled for hearing. Those of major importance—copper, lead, zinc—are published in full in this issue.

Particular interest centers in the copper code, or more precisely, codes. For after weeks of futile conference the primary producers and custom smelters were unable to harmonize their interests, and each group submitted its own code. The outcome was a direct reflection of the peculiar problems confronting the industry in controlling production and in the orderly and profitable marketing of its product. Nor has the problem been solved by submitting separate codes; the stage has merely been set for the application of more persuasive measures. Not only are two codes likely to be unacceptable to the NRA, but the primary producers have agreed in their code that "all producers, smelters, refiners and secondary metal processors whose product is sold in competition with them . . . shall be bound by the terms hereof . . . otherwise this code shall not apply." All of which sounds a note of finality that well illustrates the impasse and the need of an impartial leader who shall lay down the terms of compromise. That some form of compromise will be reached by the industry, or imposed upon it, is a foregone conclusion.

The copper mining code is interesting and unusual from another viewpoint. Considering the excessive stocks of copper, primary producers agree to limitation of production, and to allocation on a basis of productive capacity. Provision is made for increasing production as stocks are reduced. Proposals for limitation and allocation of production have already been before the NRA in the oil and lumber codes and have been approved. They are quite as essential to the stability and welfare of the copper industry and doubtless will meet with favor. In fact, in all previous proposals to relax the restrictions of the anti-trust laws in this respect, it has always been recognized that the natural resource industries are entitled to special consideration, and that control of production is a measure of conservation as well as of stability.

In the lead and zinc codes little or no attention is paid to competitive practices. Those industries content themselves with agreement on the customary clauses relating to hours and wages of labor, and contemplate the submittal of supplementary provisions or additional codes dealing with unfair and destructive competition. Evidently their problems lack the complexity of those with which the copper industry has to deal.

Re-employment and the Machine

WHEN, less than two years ago, technocracy and those who preached it had the world by the ears, and when, somewhat later, the idea seemed to have been dismissed in disgrace and ridicule from the public mind, few suspected that before twelve months had passed one of the leading industrial nations of the earth would be deliberately attempting to modify the structure of its economic and social system so that unemployment might be abolished the while

that the benefits of mechanized industry were retained. The prophet-technocrats were indeed extravagant in their assertions; doubtless they greatly underestimated the time element involved in the changes of which they spoke, but there was a vital truth in their recognition of the fact that only disaster lay in refusing to note the inevitable effect of the machine upon society and to plan the needful readjustment. For it is society that must change and not that the machine must be abolished. As sane for Athens to have killed its slaves, thereby making impossible at that time the lofty achievement of the Periclean age, as for the United States or any other nation to abandon the machine and revert to hand labor. It is the machine that will ultimately make men free from drudgery and give them time to think. And when that day at last arrives it will be the dawning of a greater age than that of Pericles.

The apparent dilemma in arguing that invention must not be retarded at the same time that one urges that employment must be increased is no dilemma. The two theses are not at all opposed, and this becomes apparent when at last one recognizes that the social structure and the habits of industry can and will be changed if a sufficient number of the people rouse themselves to demand it.

To abandon the machine is unthinkable. Who that has become well accustomed to the typewriter will return to longhand? In considering this simple, personal operation the folly of the suggestion becomes apparent. It can be made equally plain, no matter what more complicated application of the machine is selected for analysis. And it is less foolish only in degree to advocate the partial scrapping of equipment and the throttling of invention. The machine is a boon, mankind's servant. But mankind must see to it that the production and benefits of the machine are properly distributed.

Capital for Development of Gold Mines

THE FLOTATION in London of an issue of shares to provide capital to develop a gold property in West Africa provides an example of the application of sound technique to the business of mining development.

The company in question, incorporated under the Companies Act of 1929, has an authorized capital of £500,000, against which 1,694,993 shares of two shillings each were recently issued. The list was opened on June 14, and closed the same day at 9.20 a.m., the issue being heavily oversubscribed.

Reasons for this display of confidence on the part of the investing public are not far to seek. Gold mining is gaining well-deserved recognition as one of the most reliable and most profitable outlets for capital. But the investors in this particular instance also indicated by their action a confidence in personnel as well as in material assets and anticipated returns. The prospectus that accompanied the invitation to subscribe was a model of clarity and comprehensiveness. It outlined the most important climatic and geographical features of the property; it contained copious extracts from reports, from the consulting engineers and the general manager, that described, adequately yet succinctly, the actual indications of ore in place, with vein widths and assays, and estimates of present and prospective reserves. Information on plant and equipment on hand and the amount of capital needed to construct a mill was followed by full financial details of the history and status of the company.

The technical information supplied, however, constituted the essence of the appeal for funds. The promptness with which money became available indicated complete confidence in the personal integrity and the technical experience and ability of the engineers responsible for the facts and deductions quoted. To the name of each of these engineers was appended an indication that the requirements of a mining academy of repute had been met, as well as showing association with an engineering society that safeguards the public and preserves a high standard of ethics in the profession, by the imposition of exacting entrance requirements and disciplinary control of its members.

If the services of experienced and reputable mining engineers were utilized to a greater extent than they are; if the investing public were protected from the bad judgment and unwarranted forecasts of fabulous returns that characterize the conclusions of many so-called consultants who claim, without offering substantiatory evidence, sound knowledge and successful experience in mining and metallurgy, gold mining would gradually but surely lose its reputation as a gamble and assume a more important place in the estimate of investors.

E.&M.J. Does Not Endorse Promotion Enterprises

RECENTLY the editors of *Engineering and Mining Journal* have received a number of letters from subscribers and others, inquiring about the ten-dollar option-certificate plan of prospect or mine development sponsored by Stratton & Stratton, of Spokane, Wash. Our correspondents "understand that the plan has the endorsement of *Engineering and Mining Journal.*" This misapprehension arises from the fact that the promoter's circular states: "The *Engineering and Mining Journal* went so far as to endorse the idea back of it." This is incorrect. Ten years ago *Engineering and Mining Journal* referred editorially to the plan under the caption, "A Ten-Dollar Speculation," speaking of it as "a wrinkle in promotion that may not be entirely new, but that may, at the same time, suggest ways and means to other owners of prospects," adding that the plan was being used successfully by Stratton & Stratton, then of Wallace, Idaho. We neither endorse nor condemn the plan, nor can we pass judgment on the merits of the mining properties promoted under it. It is not within our province either to endorse promotion plans and mining properties, or to advise for or against investment and speculation. The individual recipient of the plan must reach his or her own decision as to the wisdom of making "A Ten-Dollar Speculation." We have asked Stratton & Stratton to make no further reference to *Engineering and Mining Journal* in their promotion circulars.

NON-FERROUS METAL CODES POUR IN AT WASHINGTON

Copper Producers and Custom Smelters Present Separate Proposals— Lead and Zinc Interests First to Operate Under Blue Eagle

WITH the approach of the current month, the various non-ferrous metal interests filed in rapid succession either a complete code for their respective industries or sections thereof that pertained to wages and hours of labor, the principal object in each instance being to meet the requirements of the President's Re-employment Agreement. The lead and zinc industries were the first to receive the Blue Eagle rating, by obtaining approval of the National Recovery Administration to substitutions of pertinent paragraphs in their respective Codes of Fair Competition for paragraphs 3, 6, and 9 of the PRA. Copper producers and copper custom smelters filed separate codes. Fabricators also obtained approval of the NRA to substitutions of paragraphs from the code of the Copper and Brass Mill Products Industry for those of the President's Re-employment Agreement.

The lead code was filed by the Lead Industries Association, and the zinc code by the American Zinc Institute. Leading copper producers submitted the copper code as a basic code for the copper industry. A new organization, the Copper Custom Smelters and Refineries Association, filed the custom smelter code. A code filed by the Association of Manufacturers in the Aluminum Industry covered mining and milling operations, as well as fabricating and other processing of the metal. The American Manganese Producers Association submitted a code for the domestic manganese industry.

In the paragraphs that follow are presented the major sections of (1) the code for the copper industry, as submitted by producers; (2) the code submitted by the Copper Custom Smelters and Refineries Association; (3) the code submitted by the American Zinc Institute, as revised to include the approved paragraphs substituted for those of the PRA; (4) the code submitted by the Lead Industries Association, modified, however, to contain approved paragraphs substituted for those of the PRA; (5) the approved petition presented by the Copper and Brass Mill Products Industry, containing the paragraphs substituted for those of the PRA; (6) an abstract of the manganese code.

Deputy Administrators H. O. King and K. M. Simpson have been assigned to hear the metal codes.

Code for the COPPER INDUSTRY

To effectuate the policy of Title I of the National Industrial Recovery Act and thereby conserve the resources of the Nation and to rehabilitate the copper industry, the following provisions are established as a Basic Code of Fair Competition for the Copper Industry.

Title I—Definitions

1. The term "Industry" or "Copper Industry" means and includes the business of producing and processing copper in the United States and selling the same.

2. "Copper Producers" are corporations, partnerships, associations and individuals engaged in the copper industry.

3. "Copper" as used herein includes lake copper, electrolytic copper, casting and best select copper of whatever grade, bessemer, blister and black copper of whatever grade, but does not include fabricated copper in any form.

4. "Primary Producers" are producers of "primary copper."

5. "Primary Copper" is new copper derived or procured from ores, treatment of tailings, leaching and mining operations in the United States, as distinguished from secondary metal hereinafter defined. Copper commonly known as "Custom" produced from the same sources as primary copper is considered as primary copper for purpose of this Code.

6. "Secondary Copper" or "Secondary Metal" is that copper produced in the United States by smelters, refineries and/or secondary metal processors by re-working scrap copper, scrap brass and scrap alloys containing copper.

7. "Production" includes all copper, as defined in 5 and 6 above, derived from the treatment of (a) direct smelting ores and/or (b) all forms of copper-bearing material including blister above ground, and unreported to the Copper Institute as production prior to August 1st, 1933. The intent of this definition as to primary copper production is to correlate actual mine production with copper production without an intermediate accumulation of direct smelting ores, concentrates or partly processed material.

8. "Productive Capacity" of any primary producer means the tons of copper which such producer is able to produce with its present plant and equipment in a period of one year, but capacities are relative and do not necessarily signify the maximum which any signatory is able to produce in a single year.

9. The "Production Quota" of a primary producer is that percentage of its productive capacity which it, at the time, is entitled to produce under the terms of this Code.

10. "Cost of Production" meaps the weighted average cost of the primary production of all primary producers signatory hereto which shall include all expenses incurred in the production, marketing and delivery of copper, maintenance, depreciation, overhead and all taxes other than income.

11. Consumption of copper for any month for the purposes of this Code shall be measured by the deliveries of copper from refineries to domestic consumers, excluding shipments of copper to domestic consumers on consignment and deliveries of copper withdrawn from bond and scrap copper re-treated on toll, but including deliveries made from consignments to domestic consumers, averaged over a period of two months immediately preceding the month in question.

12. "Employees" includes all persons employed except members of the executive, supervisory, technical and engineering staffs.

13. "Effective Date" as used herein shall be the second Monday after the approval of this Code by the President of the United States or such other date as the President shall fix.

14. "Persons" includes natural persons, partnerships, associations and corporations.

15. "Signatory" is any person engaged in the copper industry who signs this Code.

Title II—Wages; Hours of Labor; Labor Practices

1. Employees shall have the right to organize and bargain collectively through representatives of their own choosing and shall be free from the interference, restraint or coercion of employers of labor or their agents in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

2. No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing.

3. Employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment approved or prescribed by the President.

It is understood that satisfactory existing relationships between employees and employers shall be permitted to continue; nothing herein contained shall be construed as denying to the individual employee the right to bargain individually for the terms and conditions of his employment.

4. The operation of concentration mills, smelters and refineries is continuous throughout twenty-four hours per day and seven days per week, and daily work is divided into three shifts of eight hours each. The operation of underground mines, as a matter of safety for the men, requires the miners on each working face to have a continuing detailed knowledge of the conditions of ground and timbering. In mines the work day is divided into two shifts of eight hours each. The time periods between shifts for blasting and reconditioning of air and the time involved in change of shifts, as well as the special conditions in mining, make impracticable a decrease in the length of each shift or an increase in daily shifts.

5. On and after the effective date the maximum number of working hours for employees shall be eight (8) hours per day and forty (40) hours per week averaged over a three (3) months period.

6. On and after the effective date the minimum wages for unskilled labor shall be at the rate of 35 cents per hour except in the following cases:

The minimum rate for common labor in Arizona and New Mexico shall be 30 cents per hour.

7. Employees incapacitated through old age or physical condition for whom provision is made on a semi-pension basis are not included in Paragraphs 5 and 6. It is agreed that such employees shall not be paid less than eighty percent of the minimum rates prescribed in Paragraph 6 and that the total number of such employees at operating properties shall not be more than five percent of the total days-wage employees in the plant in which they are employed.

8. No person under sixteen years of age shall be knowingly employed.

9. (a) Office and salaried employees receiving less than $35 per week shall work not more than forty-eight hours in any one week and not more than forty hours per week averaged over a six months period.

(b) The minimum wages of office and salaried employees shall be not less than at the rate of $15 per week.

10. Each employer shall spread employment so far as practicable for the purpose of distributing the employment available from time to time among as large a number of persons as possible.

Title III—Primary Production

A. Each of the parties hereto which owns, controls or operates a copper mine agrees to limit its primary production as hereinafter provided, from and after the effective date of this Code, such limitation being necessary due to the

existence in the United States of excessive stocks of copper.

For the purposes of this Code, the relative respective productive capacities of the primary producers are hereby agreed to as follows:

Class A Producers—	Tons per Annum
Kennecott Group	366,500
Anaconda Group	225,000
Phelps Dodge Corporation	168,000
United Verde Copper Company	68,000
Class B Producers—	
Calumet & Hecla Consolidated Copper Company	45,000
Miami Copper Company	36,000
Class C Producers—	
Magma Copper Company	25,000
United Verde Ext. Mining Company	24,000
Consolidated Coppermines Company	21,000
Copper Range Company	15,000

"Class A Producers" shall include those producers having an annual productive capacity as listed in the above schedule in excess of 45,000 tons per year. "Class B Producers" shall include those producers having an annual productive capacity in excess of 25,000 tons and not more than 45,000 tons per year. "Class C Producers" shall include those having a capacity of 25,000 tons per year or less.

B. Within twenty days after receipt of an application therefor, the Executive Committee provided for in this Code shall fix a productive capacity for any primary producer not listed above. Such application shall provide that upon acceptance by the applicant of the productive capacity as fixed by the Executive Committee such applicant shall become a signatory to this Code.

C. During the effective existence of this Code the percentage of production (i.e., production quota) shall not (except as hereinafter provided) exceed 20% in the case of any Class A Producer, 25% in the case of any Class B Producer and 30% in the case of any Class C Producer subscribing to this Code, unless and until

1. The Executive Committee shall, by an affirmative vote of not less than 65% of the tonnage of the productive capacity of the signatories hereto, decide to increase production; or

2. Physical stocks of U. S. duty free refined copper at refineries in the United States of America, as reported by the Copper Institute, shall have been reduced to 400,000 tons or less, at which time total current production shall be automatically increased to a point where total monthly productive quotas of primary producer signatories hereto plus all other production for said month of both primary and secondary copper shall equal:

   (a) 75% of consumption until stocks are reduced from 400,000 tons to 350,000 tons;

   (b) 80% of consumption until stocks are reduced from 350,000 tons to 300,000 tons;

   (c) 90% of consumption until stocks are reduced from 300,000 tons to an amount which shall equal the consumption for the three prior months;

   (d) Thereafter 100% of consumption.

D. When and if by a 65% tonnage vote as hereinbefore provided it is decided to increase the percentage rate of production, or if there is an automatic increase, as provided in "C" above, it is understood and agreed that except as limited in "E" below, Class B Producers and Class C Producers shall at all times have the right to produce respectively at a 5% and 10% higher percentage of productive capacity than Class A Producers. For example, when Class A Producers have the right to produce on a uniform 40% capacity basis, then Class B Producers shall have the right to produce on a 45% basis and Class C Producers on a 50% basis. When the respective production rates shall (under the provisions of C (1) hereof) have been increased above the minima they may again be reduced by a 65% tonnage vote but in no case below the minima.

E. Because of conditions peculiar to its mining operations Calumet & Hecla Consolidated Copper Company is unable to curtail its production to a point which will comply with its present minimum production quota hereinbefore specified. It is agreed that while such Company accepts and will retain the production classification allotted to it under "A" above, its permissible annual production hereunder will not be reduced below 15,000 tons unless reduced in accordance with "F" hereof. The said signatory on its part agrees that the excess production hereby allocated to it over and above its production based upon the percentage or percentages of its class in effect from time to time as fixed in "C" and "D" shall be applied against its participation in such future production increases as may become effective under this Code to the end that as soon as may be its total actual production from and after the effective date, shall not exceed the tonnage it would have been entitled to produce under its regular production classification, and in the meantime it will not increase its production in excess of the tonnage specified above, regardless of the provisions of "C."

F. Notwithstanding anything hereinbefore set forth, in no event shall any signatory be called upon to produce less than its minimum production quota as established in "C" and "E" above unless upon the written consent of such signatory after an 85% tonnage vote shall have voted for such reduction.

G. Any signatory which has not produced since June 1, 1933, on resuming production after the effective date of the Code, shall have the right to make up the tonnage of copper it would have had the right to produce (but did not produce) under its quota in the six months immediately preceding the resumption of production: provided, however, that if production is resumed within six months from the effective date of this Code, then such producer can only make up tonnage equivalent to the quota for the period which such producer was not operating as measured from the effective date of the Code to the date of resumption of operations.

Title IV—Price and Sales

The sale of copper below cost, reasonably and properly determined, is an unfair method of competition. No sales of copper by copper producers as defined shall be made at a price lower than the weighted average cost of production of primary copper in the United States by producers signatory hereto. Such weighted average cost of production shall be determined in the first instance in a manner prescribed by the Executive Committee, and the Administrator of the National Industrial Recovery Act may review from time to time the correctness of such determination. No sale of copper shall be made for delivery further ahead than the third month following the month of sale.

Title V—Secondary Production and Sales

According to available statistics the production of secondary metal in the United States has been approximately 20% of the total consumption of copper averaged over a period of years.

In lieu of a special limitation on the receipt or treatment of secondary metal or on the sale of secondary copper by custom smelters, refineries and/or secondary metal processors they will maintain generally the then prevailing market price; and in recognition of the principle that it is unfair competition to sell at below cost they will sell in no event at a price lower than the weighted average cost of production of the primary producers signatory hereto, as provided in Title IV hereof.

No sale of copper shall be made for delivery further ahead than the third month following the month of sale.

Title VI—Organization and Administration

The administration of this Code shall be under the direction of an Executive Committee consisting of as many members as there shall be signatories to this Code, each signatory being entitled to name one and only one member thereof.

Each signatory likewise shall be entitled to name an alternate or alternates entitled to sit on said Committee in the order designated by the member in the event of the absence of the member.

The Executive Committee shall have the power expressly conferred upon it by the Code and such other powers as may be necessary properly to administer the Code and to make its purpose effective. It shall select a Chairman and appoint, discharge and fix the compensation of, a Secretary and Treasurer and such other person or persons as may be necessary. Votes of the Executive Committee shall be on a tonnage basis.

The Executive Committee may make rules or by-laws governing the conduct of its functions hereunder.

The Executive Committee shall have the power to appoint other Committees as may be deemed necessary. Such other committees need not be composed of members of the Executive Committee. The Executive Committee may prescribe such rules and regulations to such other committees as may seem desirable and may delegate to such Committee or Committees such of its authority and powers as it may deem necessary to effectuate the purposes of this Code.

All communications and presentations of any matter affecting the copper industry shall be made through the Executive Committee. If any member shall have requested the Executive Committee to take action on a matter, the Committee shall act within ten (10) days after such request has been made upon it by mail or otherwise, addressed to the Chairman or Secretary thereof; and any member shall have the right to make direct presentation to the President of the United States of any matter provided the Executive Committee shall have an opportunity to act prior to any such presentation.

Every producer of primary copper, signatory hereto, through its representative shall have one vote for every full 1,000 tons of annual productive capacity as set out in subdivision "A" of Title III hereof. Said method of voting is herein referred to as a "Tonnage Vote."

A tonnage vote aggregating not to exceed 200 votes shall be allocated to custom smelters, refineries and/or secondary metal processors, of which an aggregate of 150 votes shall be allocated to American Metal Company, Ltd., American Smelting & Refining Company, Nichols Copper Company and Raritan Copper Works, Inc., in proportion to their participation in the secondary copper business. The remaining 50 votes may be allocated to other custom smelters, refineries and/or secondary metal processors pro rata according to their participation in the secondary copper business. The said votes shall be allocated to the respective custom smelters, refineries and/or secondary metal processors by the Executive Committee, and may be exercised by them, only as and when they become signatories to this Code. Smelters, refineries and/or secondary metal processors (or their representatives on the Executive Committee) may vote only upon matters arising under Titles II and V of this Code and on other matters shall have no vote.

This Code may be amended, added to, or supplemented. Application for amendment, addition or supplement may be made to the Executive Committee by any signatory. Such application shall be in writing and shall set forth specifically what the proposed amendment, addition or supplement is designed to accomplish. Within ten (10) days after receipt of such application the Executive Committee shall hold a meeting at which such application shall be considered and action taken thereon, subject to the approval of the President.

Any amendment to the provisions of this Code shall require an 85% tonnage vote, provided however that no decrease in the produc-

H. O. King

On completion of his high-school education, Mr. King began his career as an office boy with Castle & Company, Chicago. In 1915 he organized a company of his own for the manufacture of tools, dies, and pressed metals. He helped organize the Bassick-Alemite Corporation in 1923, and acted as vice-president and general manager of the Bassick Company, of Bridgeport, Conn. Five years later he joined H. E. Talbott & Company, of New York. Mr. King, besides his connection with the Talbott company, is a director of the Sikorsky Aviation Corporation and a number of other organizations

tive capacity of any signatory shall be effective without the affirmative vote or written consent of the signatory concerned.

In all cases in which no specific provision is made in this Code a 60% tonnage vote (whether of the Executive Committee or signatories) shall control. Action by the signatories on any matter shall be by a vote at a meeting called for that purpose or without a meeting by a written or telegraphic vote filed with or sent to the Executive Committee.

Title VII—Expenses

The expenses of administering the Code shall be borne by the signatories. The Executive Committee may from time to time make such assessments as shall be necessary against the signatories. Such assessments shall be payable as specified by said Committee. The assessment against each primary producer signatory shall bear the same relation to the total that the production quota of that signatory under Title III bears to the total production quotas. Signatories who are not primary producers shall be assessed on the basis of the percentage which their sales bear to total sales in the same period.

K. M. Simpson

As prospector, miner, mining superintendent, and manager of mining and metallurgical plants, Mr. Simpson has been closely associated with the mining industry ever since his graduation from Columbia University in 1906. During the War he served as a technical adviser in the War Department and as an unofficial member of the British War Mission. Since that time he has been engaged as a consulting engineer in New York, making frequent visits to England and the Continent in connection with professional activities. With Mr. King, opposite, he will conduct hearings on the metal codes.

Title VIII—Reports

With a view of keeping the President of the United States or his designee informed as to the observance or non-observance of this Code and as to whether the copper industry is taking appropriate steps to effectuate the declared policy of the Government as expressed in the National Industrial Recovery Act, each signatory will furnish reports as requested.

Title IX—Agreements Relative to This Code

The members of the industry which have signed this Code agree that the provisions thereof shall be the standards of fair competition for the copper industry in the United States, and that every violation of the standards established in the Code shall be deemed an unfair method of competition in commerce within the meaning of the Federal Trade Commission Act as amended, and shall subject the party guilty of any such violation to penalties as provided in Title I of the National Industrial Recovery Act.

The signatories have likewise executed this Code upon the condition that all producers, smelters, refiners and secondary metal processors whose product is sold in competition with them and which are not signatory hereto shall be bound by the terms hereof either by becoming parties hereto or by license from the President of the United States authorizing them to engage in business in competition with all signatories hereto on a basis which shall in no respect be more favorable to such competitors than the basis provided for under this Code; otherwise this Code shall not apply.

The intention and purpose of the signatories to this Code is that it shall so operate as not to promote monopolies or to eliminate or oppress small enterprises nor by its operations to discriminate against them but rather that it will tend to effectuate the policy of the National Industrial Recovery Avt.

Nothing contained in the Code shall be deemed to constitute the signatories thereof as partners for any purpose.

It is recognized by the signatories that in case any provisions of this Code (including the provisions of Title IV) are determined by the President or the Administrator to operate unsatisfactorily in the public interest or to the substantial prejudice of any signatory, the President may cancel and nullify this Code, excepting as regards the right of the President to continue the provisions in regard to maximum hours of labor, minimum rates of pay and other conditions of employment as provided by Title II of the Code.

Title X—Modification, Alteration or Amendment

This Code and any provision thereof shall be deemed cancelled or modified to the extent necessary to conform with any order, approval, license, rule or regulation issued by the President of the United States, under the authority of Section 10 (b) of the National Industrial Recovery Act.

The foregoing Code of Fair Competition has been agreed to by the undersigned members of the copper industry of the United States, acting through their officers thereunto duly authorized, who hereby represent to the President of the United States or his designee that they constitute the greater part of copper industry in the United States, and in excess of ———% of the production of primary copper.

The provisions of this Code shall expire on June 16, 1935, or on the earliest date prior thereto on which the President shall by proclamation, or the Congress shall by Joint Resolution, declare that the emergency recognized by Section I of the National Industrial Recovery Act has ended.

This Code may be executed in any number of counterparts. The total number of such counterparts shall together constitute the Code of the Copper Industry and shall be read and interpreted as if all the signatories had executed one and the same instrument.

Code for COPPER CUSTOM SMELTERS AND REFINERIES

The subscribers to this Code, submitted by the Copper Custom Smelters and Refineries Association for its members, represent a majority of the tonnage. The Association affirms that it imposes no inequitable restriction on admission to membership and participation in its activities and that it is truly representative as a national trade association of the Copper Custom Smelters and Refineries.

These subscribers, being desirous of furthering the policy of the National Industrial Recovery Act, have, pursuant to the provisions of Section 4 of said Act and subject to the approval of the President, formed a voluntary association, known as "Copper Custom Smelters and Refineries Association," and jointly and severally have mutually agreed to be bound by the following

Labor Provisions

1. (Statutory) The parties hereto shall observe and respect the provisions of Section 7(a) of the National Industrial Recovery Act, providing as follows:

> "(1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (2) That no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and (3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President."

2. (Hours of Labor) On and after the effective date of this Code employers shall not operate on a schedule of hours of labor for their employees exceeding the equivalent of forty (40) hours per week when averaged over the period from the effective date of this Code until October 1, 1933, or over any of the successive thirteen week periods ending, respectively, December 31, 1933, April 1, 1934, and July 1, 1934, etc., nor a total of more than 520 hours in any of these thirteen week periods. Such maximum working hours shall not apply in the case of accidents or emergencies where the safety of the men or the preservation of the property necessitates temporarily longer hours. It is also recognized that in various divisions there are individual circumstances which may call for special consideration and the working of a greater number of hours than herein specified which shall be permitted upon approval by the National Recovery Administration.

3. (Mininmum Wages) The minimum wage shall be thirty-five cents (35c.) per hour unless the hourly rate for the same class of work on July 15 1929, was less than thirty-five cents (35c.) per hour, in which latter case not to be less than the hourly rate of July 15, 1929, and in no event less than thirty cents (30c.) per hour.

Other Labor: The foregoing schedule applies to all employees, clerical as well as others.

No female labor is employed in the smelting and refining business, except in clerical positions.

No minor under the age of sixteen years shall be employed.

In all plants, skilled labor is employed, which is paid wages in excess of those above specified for common and unskilled labor, and this skilled labor has in many cases been working more than forty (40) hours per week. Equitable adjustment will be made with this class, both as to hourly rate and number of hours employed.

Code of Fair Competition

The parties hereto do not at this time find it necessary to file a Code of Fair Competition. They may hereafter wish to file such a Code. In filing this Labor Code, the parties and Association reserve the right of filing later such Code of Fair Competition and Trade Practices as may seem desirable under the circumstances.

Compliance With Policies of the Act

The subscribers hereto declare that the Code is not designed to promote monopolies or monopolistic practices nor to eliminate nor oppress small enterprises, and will not operate to discriminate against them; that it will tend to effectuate the policy of the National Industrial Recovery Act; that this Association is truly representative of the trade and industry in which the subscribers are engaged, and represents, by its signatories, all copper custom smelters and electrolytic refineries in the United States which are not owned or controlled, directly or indirectly, by a company whose primary interest is that of a miner and producer of primary copper and not that of custom smelting and refining; that this Code imposes no inequitable restrictions on admission to membership in this Association, but shall permit any processor of copper materials to join by becoming a signatory hereto or to a counterpart hereof.

Reports

To inform the President as to the observance of the provisions of this Code by its subscribers and as to the steps the Copper Custom Smelters and Refineries are taking to effectuate the declared policy of the National Industrial Recovery Act, each person engaged in the industry shall provide certified statements at the end of each period referred to under the paragraph hereinabove entitled "Hours of Labor", to the effect that the employer has complied with the maximum hours and minimum rates of wages prescribed herein.

Cancellation or Modification

This Code or any of its provisions shall be cancelled or modified and any approved rule issued thereunder shall be ineffective to the extent necessary to conform to any action by the President under Section 10(b) of the National Industrial Recovery Act in cancellation or modification of any order, approval, license, rule or regulation pertaining thereto.

Code for the ZINC INDUSTRY

To effectuate the policy of Title I of the National Industrial Recovery Act, during the period of the emergency, by reducing and relieving unemployment, improving the standards of labor, relieving the disastrous effects of overcapacity and otherwise rehabilitating the zinc industry, and by conserving the natural resources of the nation, and in other respects, the following provisions are established as a basic code of fair competition for the zinc industry:

I

The American Zinc Institute, Inc., affirms that it imposes no inequitable restrictions on admission to membership and participation in its activities, and that it is truly representative as a national trade association of the zinc industry in its several branches.

II

Definitions: The zinc industry comprises the production of zinc ores and concentrates, slab zinc, zinc dust, rolled zinc, zinc oxide, lithopone, zinc sulphide, and sulphuric acid. The several divisions of the zinc industry, as referred to herein, are as follows:

The Mining Division is defined to include the mining and concentrating of ores in which zinc constitutes, by weight, the principal recoverable non-ferrous metal. For simplicity in applying this definition, the actual metallic content of the ore shall be considered, without regard to whether the zinc is recovered in the form of slab zinc, zinc oxide or other zinc compounds.

The Prime Western Smelting Division is defined to include the production of prime western, selected, brass special and intermediate grades of slab zinc by the distillation process, excluding the production of plants which treat secondary materials only.

The High Grade Zinc Division is defined to include the production, by distillation or by electrolytic refining, of high grade zinc, excluding the production of plants which treat secondary materials only.

The Secondary Zinc Division is defined to include the production of slab zinc of all grades, and zinc dust, and the treatment of zinc ashes, by plants which treat secondary materials only.

The Rolled Zinc Division is defined to include the production of rolled plate, sheet, strip and ribbon zinc.

The Zinc Oxide Division is defined to include the production of zinc oxide, both lead-free and leaded grades, whether from metallic zinc, zinc ores or other zinc compounds.

The Lithopone Division is defined to include the production of all grades of lithopone, including ordinary lithopone, high strength lithopone, titanated lithopone and calcium base lithopone, and also the production of zinc sulphide.

The Sulphuric Acid Division is defined to include the production of sulphuric acid as a by-product of the roasting and/or sintering of zinc ore, in the same plants as those in which the roasting or sintering is conducted, including the production of sulphuric acid from brimstone used to supplement the by-product production.

The term "employees" as used herein shall include all persons employed in the conduct of the respective operations, except executives and their immediate assistants, supervising, technical, maintenance and engineering staff.

The term "effective date" as used herein is defined to be the second Monday after this Code shall have been approved by the President.

The term "persons" shall include natural persons, partnerships, associations, and corporations.

In the mining division of the zinc industry, the several mining districts, as hereinafter referred to, are defined as follows:

Eastern District—New York, New Jersey, Pennsylvania.
Southern District—Virginia, Tennessee.
Mississippi Valley District—Wisconsin, Illinois, Missouri, Kansas, Oklahoma, Arkansas.
Northwestern District — Colorado, Utah, Nevada, Montana, Idaho, Washington, Oregon, California.
Southwestern District—New Mexico, Arizona.

In the prime western smelting division of the zinc industry, the several smelting districts are defined as follows:

Eastern District—Pennsylvania, West Virginia.
Midwestern District—Indiana, Illinois.
Southwestern District — Kansas, Oklahoma, Arkansas, Texas.

III

On and after the effective date, the minimum wage that shall be paid by employers in the several divisions of the zinc industry to any of their employees shall be as follows:

Mining Division. The minimum wage shall be at the rate of 35c. per hour in the Eastern and Northwestern Districts and 30c. per hour in the Southern, Mississippi Valley and Southwestern Districts.

Prime Western Smelting Division. The minimum wage shall be at the rate of 30c. per hour for common or unskilled labor, and at the rate of $2.75 per shift (of not to exceed 6 hours) for all other labor.

High Grade Zinc Division. The minimum wage shall be at the rate of 39c. per hour.

Secondary Zinc Division. The minimum wage shall be at the rate of 35c. per hour, except for cleaners and outside labor, for which the minimum wage shall be at the rate of 30c. per hour.

Rolled Zinc Division. The minimum wage shall be at the rate of 35c. per hour, except for cleaners and outside labor, for which the minimum wage shall be at the rate of 30c. per hour.

Zinc Oxide Division. The minimum wage shall be at the rate of 35c. per hour.

Lithopone Division. The minimum wage shall be at the rate of 35c. per hour.

Sulphuric Acid Division. The minimum wage shall be at the rate of 35c. per hour, except for cleaners and outside labor, for which the minimum wage shall be at the rate of 30c. per hour.

IV

On and after the effective date, employers in the several divisions of the zinc industry shall not operate on a schedule of hours of labor for their employees exceeding the equivalent of 42 hours per week when averaged over the period from effective date until October 1, 1933, or over any of the successive thirteen week periods ending respectively December 31, 1933, April 1, 1934, July 1, 1934, etc., nor a total of more than 546 hours in any of those thirteen week periods. Such maximum working hours shall not apply in the case of accidents or emergencies where the safety of men or the preservation of the property necessitates, temporarily, longer hours; nor in the case of the mining division shall it apply to hoist men, power house men or pump men. It is also recognized that in the mining division there are individual circumstances, such as shortage of labor or housing facilities, which upon proper showing of facts in such cases, may call for special consideration by the National Recovery Administration and the working of a greater number of hours than herein prescribed.

V

Employers in the zinc industry shall comply with the requirements of the National Industrial Recovery Act as follows:

"(1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and (3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President."

VI

On and after the effective date, employers in the zinc industry shall not employ any minor under the age of sixteen (16) years.

VII.

With a view of keeping the President informed as to the observance or non-observance of this Code of Fair Competition, and as to whether the several divisions of the zinc industry are taking appropriate steps to effectuate the declared policy of the National Industrial Recovery Act, each person engaged in one or more divisions of the industry shall furnish reports in substance as follows, and in such form as may hereafter be provided:

(a) **Wages and Hours of Labor.** Certified statements at the end of each period referred to under Section IV to the effect that the employer has complied with the maximum hours and minimum rates of wages prescribed herein.

(b) **Reports of Production, Stocks, etc.** For the mining division, monthly reports covering production, shipments and stocks of zinc ore and concentrates at mines and/or concentrating mills.

The American Zinc Institute, Inc., 60 East 42nd Street, New York City, is constituted the agency to collect and receive such reports.

The following procedure is established in order to enforce the provisions of this Code:

The Secretary of the American Zinc Institute shall notify the Executive Committee thereof of any violation of the Code or any failure to submit the reports called for by this Section; the Executive Committee shall investigate the circumstances, and in case the offending producer shall fail to correct such violation or to submit such reports within a reasonable time, the Committee shall report the matter to the Administrator of the National Industrial Recovery Act.

VIII

This code and all the provisions hereof are expressly made subject to the right of the President, in accordance with the provision of Clause 10 (b) of the National Industrial Recovery Act, from time to time to cancel or modify any order, approval, license, rule, or regulation, issued under Title I of said Act, and specifically to the right of the President to cancel or modify his approval of this Code or any conditions imposed by him upon his approval hereof.

IX

Such of the provisions of this Code as are not required to be included herein by the National Industrial Recovery Act may, with the approval of the President, be modified or eliminated as changes in circumstances or experience may indicate. It is contemplated that from time to time supplementary provisions to this Code or additional codes may be submitted for the approval of the President to prevent possible unfair and destructive competitive practices and to effectuate the other purposes and policies of Title I of the National Industrial Recovery Act.

X

This Code is not designed to promote monopolies and shall not be availed of for that purpose. The provisions of this Code shall not be so interpreted or administered as to eliminate or oppress small enterprises or to discriminate against them.

Approved Paragraphs From Code for COPPER and BRASS MILL PRODUCTS INDUSTRY

Article III

Section 1: Minimum Age Limit. On and after the effective date of this Code employers in the industry shall not employ anyone under 16 years.

Section 3: Minimum Wages. On and after the effective date of this Code the minimum wage that shall be paid by any employer in the Industry to any male employee shall be 35c. per hour, and the minimum wage that shall be paid to any female employee shall be 30c. per hour, and provided further, however, that the above minimum wages shall not in any way be considered as a discrimination by reason of sex and where in any case women do substantially the same work or perform substantially the same duties as men they shall receive the same rate of wage as men receive for doing such work or performing such duties; and provided further that learners and apprentices may be paid not less than 80% of such minimum wages, but the total number of such learners or apprentices shall not in any calendar month exceed 5% of the total employees.

Section 4: Maximum Hours of Work. The total number of hours in any calendar or pay-roll week which any employee, except outside salesmen, executive and supervisory staffs, and except very special cases where restrictions of hours of highly skilled workers would unavoidably reduce production, shall work, shall be 40 hours. In case highly skilled workers shall work more than 40 hours in any week they shall receive one and one-third of their hourly rate for overtime work. In case of emergencies such as those arising from the need of repairs or breakdowns, or of meeting unusual requirements of peak production or shipment, any employee, upon request of the employer, may work a total number of hours greater than said 40 hours, but not exceeding 48 hours in any one calendar or pay-roll week, provided that during each period of 13 consecutive weeks starting with the effective date of this Code no employee other than those above excepted from the provisions of this Section 4 shall have worked more than a total of 520 hours.

Code for the LEAD INDUSTRY

The subscribers to this code, submitted by the Lead Industries Association for its members, represent 90% of the active lead mining, 90% of the lead smelting and refining, 95% of the lead pigments, and more than 85% of the metallic lead products industries by tonnage in the United States of America. The Lead Industries Association, affirms that it imposes no inequitable restrictions on admission to membership and participation in its activities, and that it is truly representative as a national trade association of the lead industry in its several branches.

Purpose

Art. I. The declared purpose of this code is to effectuate the policy of Title 1 of the National Industrial Recovery Act, during the period of the emergency, by reducing and relieving unemployment in the lead industries, by improving the standards of labor therein, by eliminating destructive competitive practices, and by maintaining a reasonable balance between production and consumption of the products of these industries.

Definitions

Art. II. (a) "Lead industries" as used herein is defined to mean all those engaged in the mining, smelting and refining of lead and lead scrap and in the manufacture of lead pigments, metallic lead products, and allied products defined under "metallic lead products."

(b) "Lead Ore and Ore Concentrates" as used herein is defined to mean ore containing lead as the principal commercially recoverable constituent.

(c) "Lead mining" as used herein is defined to mean the mining and concentrating of lead ore and other treatment to the time of shipment to the smelter.

(d) "Lead smelting and refining" as used herein is defined to mean the processing of lead ore, concentrates, lead scrap, and other lead bearing material into pig lead or antimonial lead.

(e) "Lead pigments" as used herein is defined to mean basic carbonate white lead, dry or in oil, basic lead sulphate, dry or in oil, litharge, red lead, dry or in oil, orange-mineral, and other lead oxides with or without metallic lead content.

(f) "Metallic lead products" as used herein is defined to mean extruded, rolled, cast or otherwise worked lead or lead alloy products, or metallic tin, tin alloy or other metal or metal alloy products which are produced by the members of the Lead Industries Association on the same type of machinery and under similar labor conditions.

(g) "Metallic foil products" as used herein is defined to mean lead, tin, aluminum, zinc or their alloys or combinations rolled to thickness of 0.006 inches or less; or other metals or their alloys or combinations rolled on similar machinery to the same thickness or less; whether attached or affixed to other materials or not.

(h) "Persons" as used herein includes any individual, firm, partnership or corporation.

(i) "Employees" as used herein shall include all persons employed in the conduct of the respective operations, except executives and their immediate assistants, supervising, technical, maintenance and engineering staffs.

(j) "Division" as used herein refers to the several sections of the lead industries enumerated below:

1. Lead mining division.
2. Lead smelting and refining division.
3. Lead pigments division.
4. Metallic lead products division.
5. Metallic foil products division.

Effective Date

Art. III. This code shall be in effect beginning the second Monday after its approval by the President.

Labor Provisions

Art. IV. Employers in the lead industries engaged in the production and manufacture of lead and lead products shall comply with the requirements of the National Industrial Recovery Act as follows:

"(1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and (3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

Minimum Age

Art. V. On and after the effective date, employers shall not employ any person under the age of 16 years, engaged directly or indirectly in production.

Hours of Labor

Art. VI. No employees of the following divisions of the lead industry (except hoistmen, power house men and pump men in the mining division) shall be employed more than the maximum of forty (40) hours per week:

1. Lead mining division.
2. Lead smelting and refining division.
3. Lead pigments division.
4. Metallic lead products division.
5. Metallic foil products division.

Provided, however, that employees may average forty (40) hours per week over the period from the effective date until October 1, 1933, or over any of the successive thirteen (13) week periods ending respectively December 31, 1933, April 1, 1934, July 1, 1934; provided further that the hours of labor in each period will not be in excess of a total of five hundred and twenty (520) hours of labor; provided further that such maximum working hours shall not apply in case of accidents or emergencies where the safety of the men or the preservation of the property necessitates temporarily longer hours.

Minimum Wages

Art. VII. No employees of the lead industry shall be paid less than 35 cents per hour unless the hourly rates of the same class of work on July 15, 1929, was less than 35 cents per hour, in which latter case not to pay less than the hourly rate of July 15, 1929, and in no event less than 30 cents per hour. Cleaners, watchmen and outside labor shall be limited to 5% of the total number of employees and shall be paid not less than 30 cents per hour. This paragraph establishes a guaranteed minimum rate of pay regardless of whether the employee is compensated on the basis of a time rate or a piece work performance.

Administration

Art. VIII. Lead Industries Association is hereby designated the agency for administering, supervising and promoting the performance of the provisions of this code by the members of the lead industries. The Association shall be divided into five divisions as defined in Art. II, each division to be headed by a chairman appointed by the Executive Committee of the Lead Industries Association. The Executive Committee, together with each division chairman, the Secretary of the Lead Industries Association, and such representative of the Administrator as he may care to appoint, are designated to cooperate with Administrator in the administering of this code with respect to the several divisions.

Reports

Art. IX. To inform the President as to the observance of the provisions of this code by its subscribers and as to the steps the lead industries are taking to effectuate the declared policy of the National Industrial Recovery Act, each person engaged in the industry shall provide certified statements at the end of each period referred to under Article VI to the effect that the employer has complied with the maximum hours and minimum rates of wages prescribed herein.

Fees

Art. X. Each subscriber to this code shall pay his proportionate share of the cost of conducting the Lead Industries Association as prescribed in the Constitution and By-Laws, as amended, of that Association.

Cancellation or Modification

Art. XI. This code or any of its provisions shall be cancelled or modified and any approved rule issued thereunder shall be ineffective to the extent necessary to conform to any action by the President under section 10 (b) of the National Industrial Recovery Act in cancellation or modification of any order approval, license, rule or regulation pertaining thereto.

Monopolies

Art. XII. (a) This code is not designed to promote monopolies and shall not be availed of for that purpose.

(b) The provisions of this code shall not be so interpreted or administered as to eliminate or oppress small enterprises or to discriminate against them.

Additions or Amendments

Art. XIII. Additions or amendments to this code, or supplemental codes affecting or pertaining to the several divisions of the lead industries, may be submitted to the Executive Committee of the Lead Industries Association, and, upon approval by the Committee, after two weeks notice to the members, may be submitted to the Administrator of the National Industrial Recovery Act and will become a part of this code and have the same force and effect as any other provision of this code when approved by the Administrator.

Code for the MANGANESE INDUSTRY

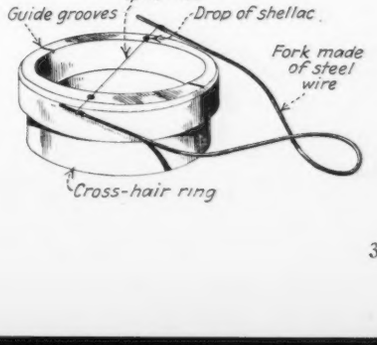
(Abstracted)

The NRA code proposed for the domestic manganese industry by the American Manganese Producers Association provides minimum rates of pay of 35c. per hour in the Western and Northern sections of the industry and 30c. in the Southern section; a 40-hr. week for the entire industry, with 1 1/3 times the regular rate of pay for any overtime (above 40 hr.) permitted; exclusion of labor under 16 years of age; and maintenance of ore prices at not less than production cost. If foreign ores or alloys are offered at a price less than "fair value," as determined by the Association's executive committee and the President of the United States, the latter is to be asked to use his powers to an extent necessary to permit domestic producers to enjoy the domestic market.

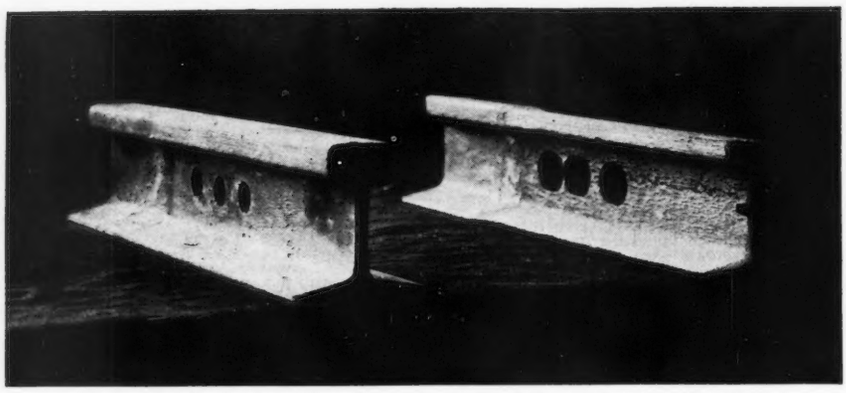
Novel Transit Repair

BROKEN CROSS HAIRS in a surveying instrument often prove an aggravating problem to the engineer in the field. George O. Lowry, of Los Angeles, Calif., recently faced with a similar matter on a field trip in northern Mexico, solved the difficulty in the following simple manner:

First the cross-hair ring was removed from the instrument and the guide grooves were thoroughly cleaned. Next a fork was made from a short piece of steel wire and a spider web secured between the ends of the fork—the spring-like action of the fork insuring proper tension of the suspended web. The web was then held for a few seconds over a vessel of boiling water and subsequently placed carefully into the guide grooves of the ring and secured by two drops of shellac, as indicated in the accompanying sketch. Ultimately the fork was removed by severing the ends of the web. Failure to heat the tightened web resulted in slack cross hairs.



Copper-Bearing Steel Rails For Mine Use



Test rails show value of copper content in resisting action of acid water

J. O. Greenan

General Superintendent, Benguet Consolidated Mining Company, Antamok, Benguet, P. I.

THE flow of water in the Benguet Consolidated mine, in the Philippine Islands, varies from 1,500 to 5,000 gallons per minute, depending on the season. In general, the water is definitely acid, and in many places its acidity reaches a point not ordinarily found in mines. At certain places, a drip of water falling on an ordinary 16-lb. rail will render the rail unfit for use within a month. This is, of course, an extreme, but many rails were formerly replaced monthly, not on account of wear but on account of corrosion.

Replacements caused by this acid-water condition have been materially reduced by the use of steel carrying about 0.25 per cent copper. The accompanying illustration shows the result of a 30-day test in the laboratory. The two pieces of 16-lb. rail, containing respectively no copper and 0.20 per cent copper, were immersed intermittently in a 0.8 per cent commercial sulphuric acid solution, thus allowing exposure to the atmosphere for oxidation, between the periods that the rails were immersed. The solution was kept at about the same strength throughout the test, by the addition of small quantities of sulphuric acid at intervals. Correcting for the portion submerged in each case, and assuming no loss for the unsubmerged portion, the results of the test were as shown in the accompanying table.

The three holes which appear in each rail were drilled in order to get a sample for the determination of the copper content, and were originally the same size in each rail. At the end of the test, in sample No. 2, the web between the holes, and at the end of the rail, had dissolved to almost a razor-edge, whereas the dissolving effect in sample No. 1 was barely noticeable.

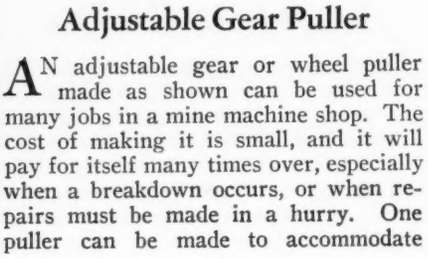
Results of Tests on Steel Rails

Sample	Copper, Per Cent	Weight Before Test, Grams	Weight After Test, Grams	Loss in Weight, Per Cent
No. 1	0.20	1,640	1,550	5.5
No. 2	nil	1,435	655	53.7

That the copper-bearing steel is ten times as resistant as the non-copper-bearing steel to the conditions encountered during the test is clearly indicated. This fact, combined with our experience in actual use, is a strong argument in favor of the use of copper-bearing rails in mines containing acid water. The cost of the copper-bearing rails is about 10 per cent greater than the cost of non-copper-bearing rails, thus indicating a large saving. The test was conducted by J. E. Atkinson, of the Benguet Consolidated staff.

Adjustable Gear Puller

AN adjustable gear or wheel puller made as shown can be used for many jobs in a mine machine shop. The cost of making it is small, and it will pay for itself many times over, especially when a breakdown occurs, or when repairs must be made in a hurry. One puller can be made to accommodate many gears of different sizes. This depends on length of top plate, which has a slotted or elongated hole to allow for gears of different widths, the bolts being opened out as desired.



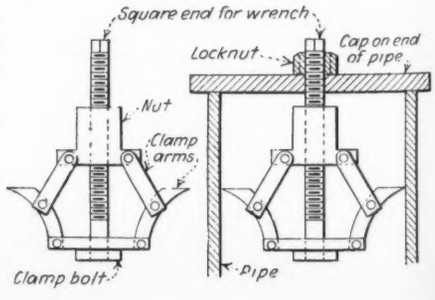
This puller operates as does the standard gear puller. The lower clamps should be kept as close to the work as possible. If the gear or pinion is exceptionally tight on the shaft, use a chain around the body of the job, over both bolts, to keep the clamps from slipping off the gear face.

The above article and that on the right appeared in the August issue with the cuts interchanged. They are here presented correctly.

Emergency Pipe Clamp

NEED to plug a 10-in. pipe, not threaded on the end, used on a water system under pressure, prompted the device illustrated, which was satisfactory for the purpose. In fact, the emergency clamp proved so efficient that it was used permanently on the end of the line.

After making the clamp as illustrated, place it in the pipe, allowing enough of the top end of the bolt to project out of the pipe so that the cap and cap nut can be set in place. Tighten up as much as possible on the square end of the bolt after it is in place in the pipe; then set the cap in place and tighten the nut. A gasket should be placed between the end of the pipe and the cap, also under the cap nut, to prevent leakage at these points. As pressure on the cap continues to force the clamp to the side of the pipe, the clamp will be rigid and secure at all times.



CHEMICAL MIGRATION

Post-Mine Phenomena in New Guinea

Roland Blanchard

FROM the theoretical point of view, much has been written about chemical migration of gold and silver in manganese-bearing ground waters. So far as I am aware, little has been published to show quantitatively the extent of such migration in nature. Recent check sampling of lodes belonging to New Guinea Goldfields, Ltd., afforded restricted opportunity to collect upon this subject certain data, here presented, to show what has happened in that district. The lodes under discussion occur along Edie Creek, a tributary of the Bulolo River. They are concentrated into two areas about 4 miles apart. The upper area is known as Edie Creek; the lower one, as the Golden Ridges.

Edie Creek

At Edie Creek a major northwest-trending fault divides the country into two structural units: a mudstone area to the southwest, and a schist-slate area to the northeast. Intruding both areas along the line of the major fault is a quartz-porphyry stock, which in the ground under discussion outcrops over a diameter of roughly ¾ mile. Smaller knobs and tongues of the intrusive outcrop locally east of the main stock. General relationships are shown on the map, which is reproduced from a geologic map by H. M. Kingsbury, chief geologist for the company. No attempt is made to describe the geology in detail; only those features pertinent to the discussion are emphasized.

Known lodes occur parallel or *en echelon* in two broad fissured belts along flanks of the quartz-porphyry stock. One is on the southwest flank, in the mudstone area; it comprises Edie No. 1, Edie No. 2, Edie No. 3, Karuka, and several minor lodes. The other is on the northeast flank, in the schist-slate area, and comprises the Day Dawn and a number of minor lodes. In neither area is an important lode known to occur more than ½ mile from the porphyry stock.

Only lodes in the southwest mudstone area were check sampled, and these alone are considered in the present discussion.

Within the mudstone area the lodes occur in both porphyry and mudstone. They consist of crushed and fissured rock, with irregular quartz bands and narrow quartz and calcite stringers constituting variably from one-quarter to three-quarters of the volume. Irrespective of the country rock or of composition of the lode matter in other respects, all are manganese-bearing to some extent, the lode material in most places being stained a jet black by soft, earthy manganese hydroxide, or wad. Locally, sections of the lode may be lean in manganese, with limonite predominating; but in no occurrence observed was the black manganese staining wholly absent over a lode length of several feet. Gold in lodes of the mudstone area exists largely in a finely divided state, not readily visible to the unaided eye. These statements apply to conditions within the oxidized zone, the only ground explored at the time of my visit. The source of the manganese is undetermined beyond the fact that at one place, of less than normal oxidation depth, rhodochrosite has been found as a prominent gangue mineral.

Table I—Results of Drift Sampling, Old Workings, Edie No. 1

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver, Oz.
	At 2-in depth		
30	24	2.100	62.000
35	33	1.050	43.850
40	34	2.900	54.200
45	33	4.400	72.700
50	33	1.250	60.950
55	58	1.000	28.450
Average	35.83	1.991	50.411
	At 8-in. depth		
30	24	1.600	60.900
35	33	1.525	35.625
40	34	2.050	43.250
45	33	1.700	49.300
50	33	1.225	52.950
55	35	0.550	24.650
Average	32.00	1.428	43.462
	At 12-in. depth		
30	25	0.875	44.525
35	25	0.475	57.875
40	34	0.950	54.750
45	34	1.325	45.050
50	37	2.025	48.250
55	33	1.700	35.050
Average	31.33	1.288	43.381

At Edie No. 1

Edie No. 1 lode occurs along a zone of fissuring within the quartz porphyry, locally touching an inclusion or projection of mudstone for a short distance. The lode dip is variable, but ranges mostly between 57 deg. and vertical. Exploration at the time of my visit consisted principally of an adit driven into the hill, which cut the lode at 30 ft., and thereafter followed it as a drift for more than 800 ft. Greatest depth attained by the adit is less than 150 ft.

For convenience of discussion, Edie No. 1 underground workings are divided into two parts: old workings, running from the portal of the adit to the 464-ft. mark; and new workings, from the 464-ft. mark to exploration limits.

Old Workings

In the old workings, the lode carries little or no limonite, lode material is highly manganiferous, and ground-water circulation is rapid. Near the portal, water drips almost constantly from the back of the drift. Elsewhere, the drip is more irregular, but the lode is everywhere damp.

To test for migration of gold and silver, experimental sampling was done for the 30- to 55-ft. stretch. This stretch had stood upward of two years at time of my visit, and had stood nearly a year longer than other workings upon the lode. Samples were cut from channels across the lode at successive depths of 2, 8, and 12 in. above the original back of the drift, and in each case a uniform mass of material from 2 to 4 in. wide, and 1 to 2 in. deep, was obtained as the sample, the width and depth of individual samples varying with local conditions. This yielded 4 to 6 lb. of sample per linear foot for each cut, or a 20- to 30-lb. sample per 5-ft. cut of lode. Results are given in Table I.

In all cases, width shown in the table represents the full width of strongly manganese-stained lode material.

A general decrease of gold with depth of sample is shown throughout this series except for the 50- and 55-ft. samples at 12-in. depth. At these places the samples included small amounts of a sugary, white quartz — known from sampling elsewhere in the mine to carry erratic, moderately high gold content—which was not present in the corresponding 2- and 8-in. cuts. All other samples consisted of essentially uniform lode material for cuts at the different depths. Silver is much more erratic than gold, but in a broad way shows also a general decrease with depth.

As a check against these results, longer cuts were made for the same 30-55 ft. stretch, this series of samples being taken to include manganese-streaked portions in hanging wall and footwall wherever such streaks were present. Where no such streaks existed in hanging wall or footwall, samples and assays from preceding series are used in the table. Results are given in Table II.

Samples to correspond to the 2-in. depths were not taken for these longer cuts, for the reason that the hanging-wall and footwall streaks had been broken out unevenly in preparing the lode for the first sample series.

For the longer cuts decrease in gold with depth is consistent for all samples except at 55 ft., an explanation for which has been offered. Silver again is erratic.

Because of frequent partial caving of the damp lode material when overhead lagging was pulled, only intermittent samples at 2-in. depth were obtainable in workings beyond the 30-55 ft. section. Their testimony consequently is less convincing than where consecutive samples were procured. The samples, seven in number, show the results given in Table III[1].

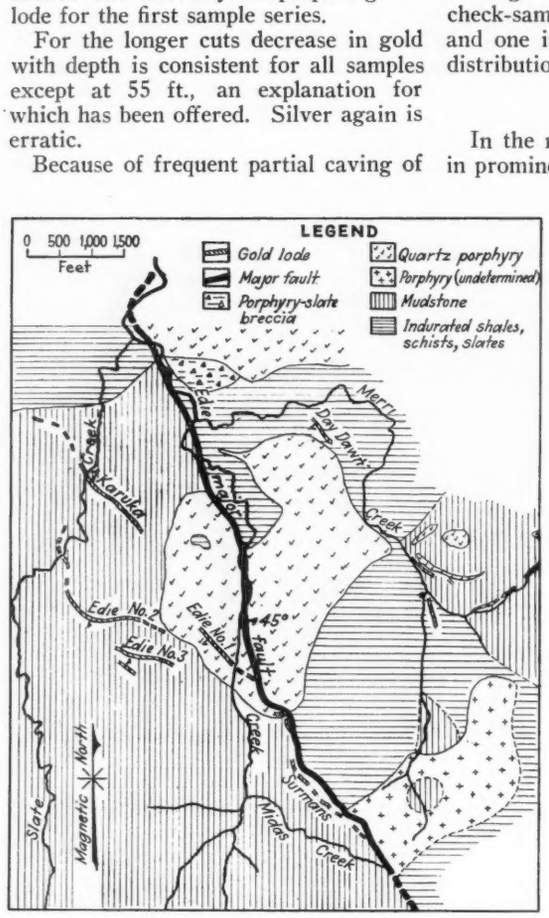
Excluding samples at 130 ft., which at 12-in. depth included much more of the white, sugary quartz than was present at 2-in. depth, we obtained the results given in Table IIIA.

At 12-in. depth the gold content in the check samples, except near the portal, coincides on averages closely with the gold content of mine samples taken immediately after blasting. Final check samples accordingly were cut at that depth. Closeness of the check is attested by the data in Table IV, representing one of the longer stretches check-sampled in the older workings, and one involving exceptionally erratic distribution of gold.

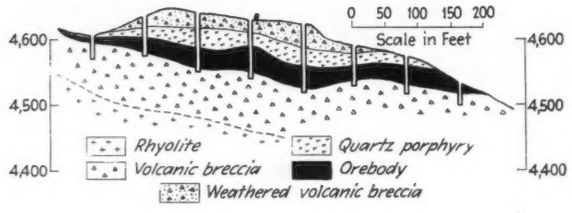
New Workings

In the new workings, limonite comes in prominently as lode matter beginning near the 500-ft. mark, and increases irregularly until, at 700 ft. and beyond, it predominates markedly, with manganese stain spotty and streaky, and on the whole subordinate in amount. The lode therefore differs somewhat in character from that in the old workings. Water circulates through the lode after heavy rains, but does not drip as much as in the old workings, due in part possibly to greater depth beneath surface and to more compact lode material at this place.

The new workings had stood only two to four months at the time of check



Preliminary geological map of Edie Creek district, New Guinea. After H. M. Kingsbury



Generalized section through Golden Ridges orebody, Wau, New Guinea. Adapted from detailed sections by H. M. Kingsbury

Table II—Results of Drift Sampling

Longer Cuts Than in Table I

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver, Oz.
	At 10-in. depth		
30	24	1.600	60.900
35	41	1.237	29.347
40	51	1.375	30.192
45	53	1.096	33.621
50	53	0.772	35.016
55	59	0.326	16.250
Average	46.83	0.988	31.321
	At 14-in. depth		
30	25	0.875	44.525
35	25	0.475	57.875
40	51	0.642	37.858
45	47	0.650	12.500
50	62	0.628	25.412
55	57	0.715	21.518
Average	44.50	0.662	29.511

Table III—Results of Drift Sampling, Old Workings, Edie No. 1

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver, Oz.
	At 2-in. depth		
125	56	2.175	70.975
130	40	2.550	74.000
170	34	0.725	62.425
175	30	0.400	32.150
180	42	0.350	29.950
185	39	0.300	30.100
190	42	1.300	54.200
Average	40.43	1.207	52.048
	At 12-in. depth		
125	56	1.740	44.237
130	47	3.302	72.722
170	34	0.556	34.184
175	30	0.450	37.275
180	42	0.212	22.412
185	39	0.346	30.954
190	42	0.589	54.468
Average	41.43	1.145	43.489

Table IIIA—Results of Drift Sampling, Summarizing Table III Results, Omitting Samples Taken at 130 Ft.

Number of Samples	Depth, In.	Average Width of Lode, In.	Gold, Oz. Average	Silver, Oz. Average
6	2	40.50	0.985	48.435
6	12	40.50	0.728	37.133

Table IV—Final Check Samples Compared, Old Workings

Distance From Portal	Number of Samples	Depth, In.	Average Width of Lode, In.	Gold, Oz. Average	Silver, Oz. Average
Mine 115-190	16	x	41.69	1.207	35.764
Check 115-190	16	12	44.19	1.167	42.993

Table V—Results of Sampling New Workings, Edie No. 1

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver, Oz.
	At 2-in. depth		
485	22	1.925	8.625
490	30	1.650	10.150
495	56	0.950	4.900
500	35	2.075	14.375
505	39	0.350	13.100
510	33	1.375	24.375
515	13	2.150	19.950
520	23	1.375	10.325
525	22	1.800	4.600
530	36	1.100	13.700
535	69	1.275	35.175
540	56	1.175	17.125
545	72	0.950	18.800
550	28	0.575	16.975
555	30	0.975	44.275
560	39	0.900	50.250
565	39	1.575	40.425
570	39	1.200	26.650
575	63	1.000	36.850
580	48	1.575	27.125
585	51	1.000	45.700
Average	40.14	1.148	24.616
	At 8-in. depth		
485	22	2.200	7.100
490	30	2.150	10.450
495	45	0.500	11.300
500	35	1.875	13.075
505	39	2.800	27.700
510	36	1.900	11.000
515	15	3.725	37.775
520	21	1.900	19.400
525	22	1.775	8.576
530	36	1.125	19.175
535	69	1.650	26.250
540	56	0.800	20.800
545	61	0.875	25.625
550	28	1.250	32.600
555	30	1.100	60.550
560	39	1.350	55.350
565	39	1.800	54.800
570	39	1.750	12.950
575	63	1.550	34.450
580	48	0.775	21.625
585	51	0.825	46.275
Average	39.24	1.466	27.188

[1]Experimental samples beyond the 55-ft. mark were not taken at 8-in. depth, inasmuch as work already done had shown conclusively that valid check against the original mine samples probably could not be obtained at that depth in the old workings.

sampling, and experimental cuts had shown that valid check samples could be obtained at 8-in. depth. The firmer ground had permitted taking a complete series of samples at 2-in. depth. Results are given in Table V.

Lode material for this stretch was nearly uniform for both the 2-in. and 8-in. cuts. Of the 21 samples taken, fourteen show decrease in gold for the 2-in. cuts, and of the seven which do not show decrease, only four contain more than 0.175 oz. increase.

This result is opposite to that obtained in the old workings, and suggests gold impoverishment rather than enrichment.

The 485-585 ft. stretch includes a short section of ground in which the decomposed country rock adjoining the lode appears to be mudstone. The gold and silver content here did not appear to be more erratic than where quartz porphyry constituted both walls of the lode, nor was it observed that impoverishment here deviated from the general trend shown elsewhere.

The next stretch check sampled showed the results given in Table VI.

Table VI—Results of Sampling New Workings, 700-770 ft.

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver Oz.
	At 2-in. depth		
700	66	0.475	5.975
705	51	0.800	2.350
710	49	0.925	7.875
715	50	1.250	19.300
720	46	2.525	30.875
725	36	1.825	51.571
730	38	2.125	20.625
735	43	2.800	33.500
740	52	2.783	58.422
745	49	2.400	26.900
750	67	4.100	30.650
755	68	2.150	29.150
760	65	1.750	13.350
765	68	1.712	16.612
770	87	1.900	20.300
Average	55.67	1.967	23.379
	At 8-in. depth		
700	66	0.600	6.900
705	51	0.325	1.675
710	36	1.375	5.825
715	39	1.850	20.350
720	46	3.125	48.975
725	38	2.604	62.880
730	38	1.647	24.474
735	43	2.225	29.475
740	57	2.219	42.211
745	55	2.147	37.860
750	67	3.409	41.737
755	80	2.840	28.777
760	65	2.175	21.720
765	68	1.853	18.660
770	87	2.722	24.840
Average	55.73	2.133	27.288

Table VII—Final Check Samples Compared, New Workings

Number of Samples	Average Width of Lode, In.	Gold, Oz. Average	Silver, Oz. Average
Mine 62	42.11	1.550	27.205
Check 62	42.71	1.465	32.684

Table VIII—Results of Sampling, Edie No. 2

Distance From Portal	Width of Lode, In.	Gold, Oz.	Silver, Oz.
	At 6-in. depth		
808	49	2.000	81.800
813	41	2.600	83.800
818	42	2.000	73.750
828	38	1.950	51.850
833	39	2.700	53.250
Average	41.80	2.234	69.802
	At 12-in. depth		
808	49	2.425	106.575
813	41	2.400	80.800
818	42	1.450	62.900
828	38	1.475	50.725
833	39	1.275	51.325
Average	41.80	1.789	72.277

In Table VI, of the fifteen samples taken, nine show decrease in gold for the 2-in. cuts; six show increases ranging from $\frac{1}{4}$ to $\frac{3}{4}$ oz. in samples most of which carry from 2 to 4 oz. of gold. The 700-770 ft. stretch involves the portion of Edie No. 1 lode in which the white, sugary quartz occurs in greatest abundance, and of the six samples which show increase in gold, two contain noticeably more of this quartz in the 2-in. than in the 8-in. cuts. Three of the others show no appreciable change, and one shows less quartz at 2-in. depth. With this taken into account, the 700-770 ft. stretch likewise suggests general gold impoverishment. Silver again is highly erratic, but both in the 485-585 and the 700-770 ft. stretches a fairly consistent average impoverishment in silver is shown for samples from the 2-in. cuts.

Table VII gives average results from both the mine and the check samples for total final check samples taken in Edie No. 1 workings, and suggests that depth of final cuts at the various places was correctly gaged to procure satisfactory check samples for the type of material involved and for the length of time that the workings had stood. On this basis, the condition indicated is enrichment in the old workings and impoverishment in the new.

A point to note is that, although in nearly all stretches involved, the gold assays of check samples from the deeper cuts coincide closely with corresponding assays from the mine samples taken immediately after blasting, silver assays consistently run higher in the check-sample averages.

At Edie No. 2

At Edie No. 2, only a 100-ft. stretch was check sampled in workings older than current development. The workings involved had stood upward of three months.

Edie No. 2 lode occurs wholly within mudstone. Except for difference in character of wall rock, however, lode material for the stretch involved corresponds closely with the highly manganiferous portions in the old workings at Edie No. 1, with possibly a few more narrow quartz stringers present.

Sampling already done at Edie No. 1 had suggested advisability of moderately deep cuts on the No. 2 lode to obtain satisfactory check samples. Consequently, no general series of experimental samples at successive depths was taken. In one section of ground, however, a series of five such comparative samples was cut for a different purpose. Results are given in Table VIII.

Here again, where lode material is highly manganiferous and little limonite is present, four out of the five cuts show higher content of both gold and silver in the 6-in. than in the 12-in. cuts; the sample at 808 ft. shows the opposite relationship. Successive samples were not cut at 823 ft.

According to the field notes, lode material for both the 6-in. and 12-in. depths was essentially similar at each cut, though the marked increase in both gold and silver for the sample of 12-in. depth at 808 ft. points to a special condition, possibly unrecognized. Disallowing such assumption, the testimony of the other four samples still offers strong corroboration for the condition suggested at Edie No. 1; namely, enrichment near exposures of lode in the drift where lode material is highly manganiferous, and where little or no limonite is present.

The goldfields lie in a steeply mountainous region of heavy rainfall. A native village in its tropical setting

In the Golden Ridges Area

At the Golden Ridges, the lode occurs as a flat-lying body beneath a quartz-porphyry sill. Relationships are shown in the lower cut on p. 366, generalized from Kingsbury's various geologic sections through the lode.

Golden Ridges lode material differs from that involved in the check sampling at Edie Creek in that the containing rock is a volcanic breccia instead of

quartz porphyry and mudstone. In physical appearance the lode resembles closely the Edie Creek lodes, but on the whole is more highly and more uniformly stained with manganese, contains but little limonite, and locally carries patches of a black, clayey decomposition product derived from the volcanic breccia, which clings tenaciously to shovel and boots, like Missouri gumbo. Disregarding these clayey patches, the lode in general is highly permeable to ground waters, being cut by steeply dipping fissures and by bedding plane slips, which localize seepages and subsurface watercourses. On the whole, the fissures, bedding-plane slips, and other seepages are more numerous than at Edie Creek, and are more general in distribution.

The orebody has been explored principally by sinking shafts or pits from the surface, on 80-ft. coordinates, through the quartz-porphyry sill and the underlying lode. The various pits had stood from two months to more than a year at the time of my visit, and, inasmuch as ground waters circulate freely through most of the lode material during the wet season, the lode exposed in the pits had been subject to much the same conditions of ground-water circulation as prevail at Edie Creek.

The sampling method adopted was to take cuts on four sides of the pit from prepared trenches in pit walls, similar to the samples taken at Edie Creek, but with the north and south sides ordinarily bulked as one sample, the east and west sides as another. This assured a satisfactorily large sample, inasmuch as for a 5-ft. section of lode exposed in the pit, total samples aggregating 75 to 100 lb. were obtained ordinarily. No attempt was made to cut samples at successive depths at the Golden Ridges, as work already done at Edie Creek had demonstrated the improbability of shallow cuts furnishing a satisfactory sample.

Check samples were at first taken at depths of 6 in. in the pit walls. As assay returns arrived, it became apparent that, although samples taken at this depth from cuts in firm lode material were on the whole furnishing satisfactory checks against the original mine samples taken immediately after blasting, the samples taken at that depth from cuts which involved free seepages were in general running appreciably higher in both gold and silver than had the original mine samples. As uniformity in depth of cut for all check samples from a given pit was desirable, remaining pits were sampled at 12-in. depth into the lode[2]. Results of averaging check samples cut at 6-in. depth against those cut at 12-in. depth are:

Range of average assays for individual pits in Table IX is large, and the fact that cuts at 12-in. depth were not taken in the same pits from which cuts at 6-in. depth were obtained, raises a challenge as to validity of the comparisons. Admittedly, if, in every case, a sample had been taken at 6-in. depth and then, at the same place, at 12-in. depth, and if the 6-in. samples were generally higher than the 12-in. samples, the data would be more convincing.

Unfortunately, commercial considerations precluded such experimentation. We noted, however, that individual samples at 12-in. depth in firm lode material generally coincided closely in gold content with original mine samples; that samples of 12-in. depth, which involved visible seepages, usually though not always showed higher gold content in the check than in the original mine samples; and that although large variations occurred as to individual cuts, the samples along seepages at 12-in. depth corresponded on the whole much more closely with original mine samples than did samples along seepages at 6-in. depth in the other pits. The averages of Table IX bear out this statement, and show that, for the cuts at 6-in. depth, gold in the check samples averages 42.08 per cent higher than in the mine samples; for cuts at 12-in. depth, 23.66 per cent higher. Corresponding figures for silver are 38.51 per cent and 15.74 per cent.

To an important degree, therefore, these results, in terms of average percentages for both gold and silver, corroborate results obtained at Edie Creek in the highly manganiferous portions of the lodes, though individually the pits at the Golden Ridges show large variations.

These sampling results will be discussed in the following issue.

Table IX—Results of Sampling at Golden Ridges

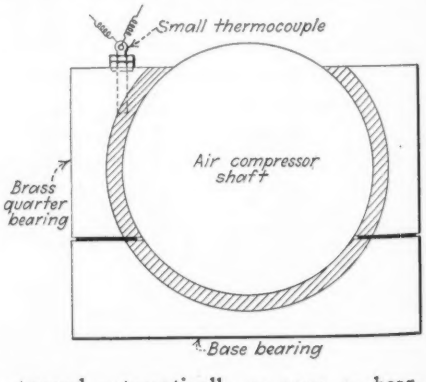
Pit	Thickness of Lode, Ft.	CHECK Gold, Oz. Average	CHECK Silver, Oz. Average	MINE Gold, Oz. Average	MINE Silver, Oz. Average
		At 6-in. depth			
A 1	10	1.375	2.325	0.615	1.100
B O	20.25	1.549	6.309	.....	.....
B O	20.50	.....	.....	1.203	3.253
B 1	25	3.782	4.567	2.680	4.120
B 2	35	0.244	1.139	0.414	1.671
B 3	25.50	0.426	1.568	0.532	1.306
C 1	11	1.286	3.105	0.850	2.155
C 2	22	0.608	1.874	.....	.....
C 2	25	.....	.....	0.304	1.194
D 1	22.90	1.996	14.278	.....	.....
D 1	22.70	.....	.....	1.581	12.187
E O	3.50	5.800	35.750	3.930	17.400
E 1	18.25	4.695	16.620	.....	.....
E 1	19.50	.....	.....	2.651	11.269
Average	193.40 (Check)	1.749	6.079	.....	.....
Average	195.70 (Mine)	.....	.....	1.231	4.389
		At 12-in. depth			
Y-2	8	0.519	1.962	.....	.....
Y-2	10	.....	.....	0.240	2.035
Y-3	11	0.241	1.068	0.453	1.127
A O	20	1.853	5.309	1.397	3.450
A 1	10	0.650	1.225	0.425	0.900
A 4	10	0.994	13.294	0.350	2.400
B 4	19	1.951	6.728	0.966	8.347
C 3	25	0.624	5.055	0.604	7.380
D O	20.75	1.437	5.657	.....	.....
D O	22	.....	.....	1.730	3.600
D 2	13.60	2.538	20.703	.....	.....
D 2	12	.....	.....	2.542	21.492
Average	137.35 (Check)	1.291	6.786	.....	.....
Average	139.00 (Mine)	.....	.....	1.044	5.863

[2]Exceptions are pits D O and D 2, where locally tight, hard rock precluded effective water circulation. Here most of the samples had to be laboriously moiled, and depths of only 6 in. were attained. Inasmuch as the local, tight character of the rock precluded effective circulation of water, and as no manganese stains were observable in the cuts beyond 2-in. depth, these pits are grouped with the 12-in. series in the comparative tables. For Pit D 2, in which the lode material was hardest and least permeable of all pits sampled, almost perfect coincidence obtains between check and mine samples.

Automatic Stopping Device

AT THE compressor plant of Empire Mines, Grass Valley, Calif., considerable trouble was experienced with a large compressor bearing. The compressor shaft had been slightly damaged by a burned-out bearing, which caused the new bearing to attain high temperatures despite repeated adjustments and occasional cooling by a small fan. Danger of burning out the bearing prevailed constantly.

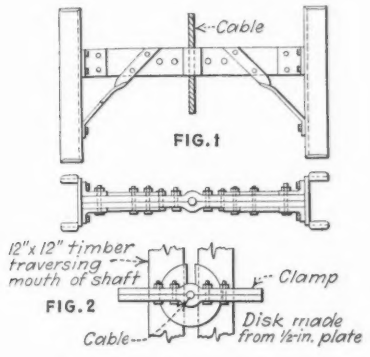
To overcome this inconvenience, Phil Keast, general repairman, developed the arrangement shown in the accompanying illustration, by which the compressor is



stopped automatically as soon as bearing temperatures rise above normal. It consists of a small thermocouple, attached to the brass quarter bearing, operating in closed circuit with the relay that actuates the trip coil on the main oil switch.

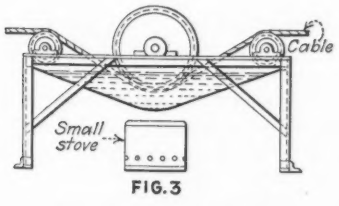
Hoisting Rope Repair

SHORTENING hoisting ropes, a job performed periodically at every mine to restore balanced hoisting and prevent undue wear of ropes, is a tedious and hazardous piece of work when suitable tools are not available. H. J. Schmitz, master mechanic of the Kennedy Mining & Milling Company, at Jackson, Calif., confronted with the task of reducing the length of the hoisting ropes every three months to avoid excessive wear at the turning coil on the drum, solved the problem satisfactorily by employing the simple contrivances shown in Figs. 1 and 2. The scheme of operation is as follows:



Shortening a hoisting rope

First, the rope is lowered to the 4,600-ft. level, and the short shoe, shown in Fig. 1, attached to the rope and to the shaft guides on the 4,000-ft. level, to reduce the loss of rope twist to a minimum. Next, a sturdy steel clamp is secured to the rope at a calculated point above the mouth of the shaft, after which the rope is lowered until the clamp rests upon the two 12x12-in. timbers traversing the shaft, as indicated in Fig. 2. The rope may then be detached from the drum and the end severed.



Apparatus for applying wire-rope lubricant

An additional factor of importance in maintaining the life and efficiency of wire ropes is the application of rope dressing at regular intervals. Various standard dressings are supplied by the market. Their application, though, is a messy job, and requires considerable ingenuity.

At the Kennedy mine this is done with the simple device shown in Fig. 3. Essentially it consists of a shallow trough supported by an angle-iron frame, and three grooved rollers to hold and guide the rope. The small stove placed under the trough serves to heat and keep the dressing compound liquid, in which condition it will saturate the rope thoroughly. Complete saturation such as this is necessary if the maximum length of life that is possible for the rope is to be obtained by the mining company.

Equipping for Hand Tramming

Hints on the Selection of Cars

Lucien Eaton

AT SMALL MINES and in narrow veins and small orebodies, where distances are too short and the quantities to be transported are too small to warrant the use of mechanical haulage, tramming is generally done by hand. One of the greatest disadvantages of hand tramming, even where unskilled labor is cheap, is that the cars used must be small. Small cars must be loaded at small chutes, and this is a great drawback, unless the ore breaks finely and runs well. But it is seldom feasible to tram by hand cars that hold more than 2 tons, and then only if men of unusually strong physique are available.

The Cars

The car most often used in hand tramming has a 16-20-cu.ft. rectangular box, 20 cu.ft. being standard. The box dumps through a door at the front end and is often mounted on a turntable. Such cars can be used under many conditions, but this general adaptability is often at the expense of efficiency. To pass readily through narrow, crooked drifts they are made narrow and relatively high, and consequently are difficult to shovel into and easy to tip over. Except in narrow drifts, a wider, lower car, such as shown in Fig. 1, is better. It has the body attached directly to the truck, and dumps over the front axle. It is light, readily sectionalized, and easy to shovel into.

Rocker-dump cars of the type shown in Fig. 2 are more common abroad than in the United States, but are increasing in popularity in the States. The body rolls sideways on an arc at each end, and, if it is narrow, the dump angle is likely to be too flat, so that discharge is not complete. This is a common fault, accentuated by the use of too wide a track gage. Gable-bottomed cars are sometimes trammed by hand, but their lower load ratios—that is, the ratio of the live load to the gross load—is not in their favor. In some mines the car box has no door and is attached directly to the truck. Such cars must be dumped by a cradle or rotary dump, and should be used only where the tonnage is large enough to warrant purchasing a dumper.

Usually, such small cars are handled by single trammers. Cars of 32 to 40

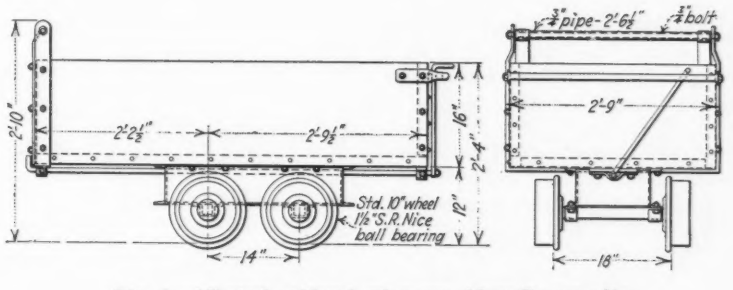


Fig. 1—All-steel sublevel mine car, 20-cu.ft. capacity

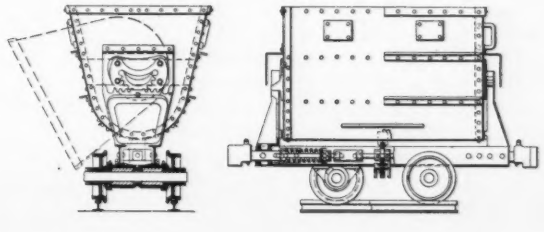


Fig. 2 — Rocker-dump car, 30-cu.ft. capacity

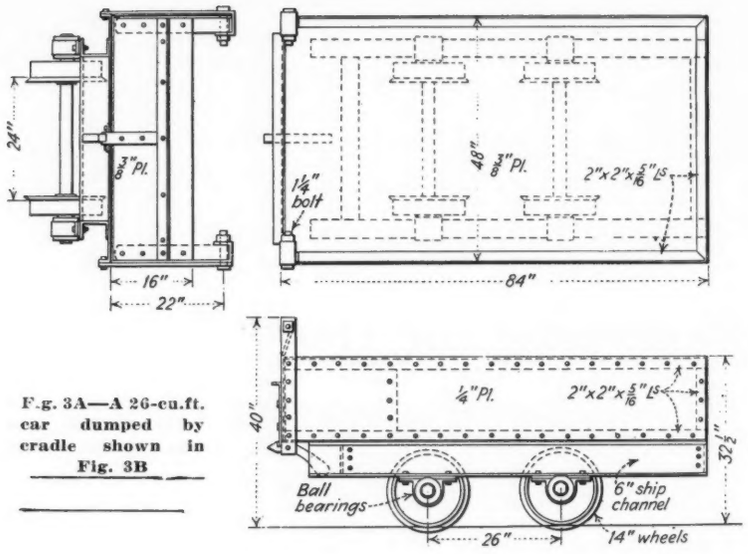


Fig. 3A—A 26-cu.ft. car dumped by cradle shown in Fig. 3B

cu.ft. capacity are sometimes used, and are trammed by two or three men. They are usually of end-dump or rocker-dump design, the former often being dumped by cradles or air cylinders. A successful design of a 26-cu.ft. car is shown in Fig. 3A, and the cradle used in dumping it is shown in Fig. 3B.

Often the same cars are used for handling both ore and waste. If waste is dumped underground, or fill spread in stopes by hand, the work may be eased by using a special car which can be dumped in any direction.

Cars were formerly built largely of wood, but this material has been superseded almost entirely by steel, with reduction of weight and bulk. Aluminum alloy will probably be used to some extent to reduce the weight further. Factory-built cars are usually light and have a fairly high load factor, but often are hard to repair in an ordinary mine shop. Shipment and repairs are facilitated if the cars are made in interchangeable sections that can be bolted or riveted together.

Hand Guards

Minor injuries to workmen, especially to their hands, are frequent in hand tramming, yet few factory-built cars have hand-guards. A light angle iron $1\frac{1}{2}$x$1\frac{1}{2}$x$\frac{1}{4}$ in. in size, inverted over the car body and fastened to the sides about 3 in. in front of the rear end of the car body, helps to prevent such injuries.

The following dimensions are recommended for the wheels of 20-cu.ft. cars: Diameter of tread, 10 in.; width of tread, 3 in.; depth of flange, 1 in.; diameter of axle, $1\frac{1}{2}$ in.; and length of hub, 5 in.

Cast iron is the usual material for wheels, the treads being chilled, but cast steel, alloy steel (especially molybdenum steel), and manganese steel are superseding it to a large extent. Manganese steel is the most durable, but cannot be machined and must be bushed, unless the wheel is pressed on.

Plain bearings are commonly used, the cast-iron wheel turning on a stationary steel axle, or both wheels may be pressed on the axle, which is free to turn in bearings. If the bearings are outside the wheels, a satisfactory arrangement is to have one tight and one loose wheel on each axle, or both wheels and axles may be loose. Introduction of tapered roller bearings and steel wheels, however, has reversed the tendency toward this design, and most manufacturers have now gone back to the loose wheel on a stationary axle. Bearings lined with marine babbitt or with brass bushings are better than plain bearings, and satisfactory results have been obtained with inexpensive ball bearings and with cylindrical roller bearings without expensive housings, when the wheels were protected from drip and the tracks were dry. Tapered roller bearings are the most satisfactory and economical in the long run, however, especially in severe service.

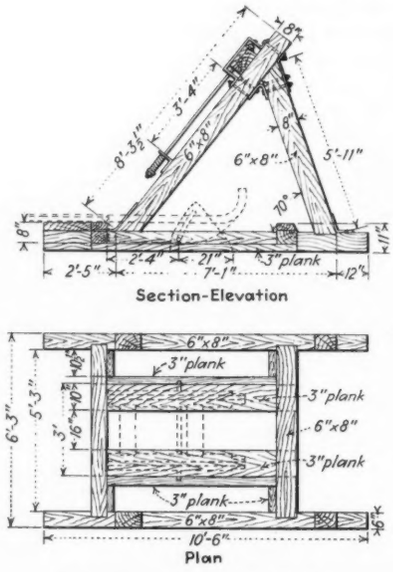


Fig. 3B—Cradle used for dumping car shown in Fig 3A

A short wheelbase is desirable for cars trammed by hand, but seldom, if ever, should it be less than the track gage. If all the wheels are loose, the long wheelbase loses some of its disadvantages and the car acquires more stability.

Tracks

Tracks for hand tramming are seldom laid with the care that they deserve, and the cost of operating is therefore unnecessarily high. Specifications for track for 1-ton cars are recommended, as given in Table I.

Table I—Track Specifications, 1-Ton Cars

Weight of rail	16 lb. per yard
Joints	standard fishplates
Gage of track	18 in.
Size of ties	4 in. thick, 5 in. wide, 3 ft. long
Spacing of ties	2 ft. center to center
Spikes	⅜ in. square x 3 in. long
Minimum radius of curvature	12 ft.

Switches should have curved rail leads and curved frogs, so that right- and left-hand frogs must be specified. Frogs are made of rail, bent and forged to shape and riveted to baseplates. The switch points may be thrown by a switch stand, or by the trammers' feet, or they may be stationary, the car being swung onto the right track by hand. This type of switch works well with 1-ton cars, but for larger cars switches with movable points are better. Useful details regarding frogs are to be found in the Goodman Mining Handbook, 5th Edition, published by Goodman Manufacturing Company.

In mines where narrow crosscuts are turned off at right angles, the radius of curvature required is less than the desirable minimum, and, if 1-ton cars are used, good practice suggests the use of "slick plates"—steel plates $\frac{1}{16}$ or $\frac{3}{8}$ in. thick, laid on the floor of the drift, on which the wheels ride on their flanges—instead of frogs and switches. By means of these plates light cars can be turned with comparatively little effort and sharp turns negotiated.

Standard gage for hand tramming is 18 in., and is the most suitable for 20-cu.ft. cars. It should be widened an inch on sharp curves, and the outer rail should be raised about an inch. Many variations from this standard are in use, and the larger cars are often of 24-in. gage.

Although theoretically a grade of 0.5 per cent in favor of the load is the best to use, because at this grade the effort required to tram the loaded car downgrade is approximately the same as that required to push the empty car back again, the best tramming records, nevertheless, have nearly always been made on tracks on which the grade was sufficient to allow the car to coast. In this way the trammers can rest as they ride the coasting cars, and, if the cars are equipped with roller bearings, the effort required to push the empty car back is not great. With roller bearings, a grade of 1 per cent is usually sufficient for coasting. A grade much steeper than this is unsafe.

Scrap and the Lead Market

Samuel Tzach

Former secondary-metals Editor of "E.&M.J. Metal and Mineral Markets"

THE outstanding development in the United States lead market in the past decade, especially in the past five years, has been the increasing production of secondary metal — lead recovered from scrap lead and alloys. This has been particularly significant for the mining industry, because smelters of ore have steadily increased their use of scrap and residues in connection with ore, or, if need be, with practically no ore, in the production of refined lead and lead alloys. The situation has been strikingly pictured by one producer — St. Joseph Lead Company—in its statements that it is today the only producer of lead made solely from ore or virgin raw material.

Awake at Last

Not only have primary lead smelters become scrap-conscious, but consumers, some of whom are also producers, have in recent years awakened to the benefits of using scrap, even for making corroding lead. Eagle-Picher only about a year ago built a plant at Newark, N. J., reputedly to produce oxide leads from battery-plate scrap, and before that it had initiated purchases of scrap for its Western plants. National Lead, for a long time a user of scrap, has in the past year purchased no fewer than three plants engaged in the production of lead and lead-base alloys from scrap, and this company has in recent years carried millions of dollars of scrap in its inventory. And only recently, too, the Glidden Company, of Cleveland, bought the secondary smelter, Metals Refining Company, of Hammond, Ind. Other large lead consumers and producers of scrap like Western Electric, General Electric, du Pont, and the railroads, have been reclaiming much of their lead scrap. Some large consumers of lead, such as storage-battery manufacturers, have at times come into the open market for scrap from which to make grid metal. Today one large Philadelphia battery manufacturer meets its battery-metal needs through a secondary smelter, and undoubtedly many minor storage-battery manufacturers have similar tie-ups with secondary smelters. Generally speaking, however, consumers find it a costly affair to enter the scrap market in competition with primary and secondary smelters and scrap dealers. The latter are, all too often, optimistically speculative and will pay a bit more for scrap than it is actually worth in the hope that by the time they sell it the price of refined lead will have risen and made scrap more valuable. Henry Ford, expanding his attempt to become an independent self-sufficient economic principality, found this out in 1927 and 1928. Outbidding regular battery-lead scrap buyers, even at garages and service stations, he fitted out two smelting plants, but found the experiment costly—just how costly was never disclosed—and wrote finis to the adventure by selling about 8,000 tons of accumulated battery-plate scrap to one of the primary smelters.

At this point, a brief explanation of terms may be desirable. Primary lead smelters, as designated in this article, denote those who use ore only or who use scrap and residues in connection with ore; and as noted in the foregoing, only one producer uses no scrap. Secondary-lead smelters are those using scrap only, although they purchase and use some virgin or refined lead, antimony, and antimony ore to add to their melts. Scrap includes material that is melted or remelted, or smelted and refined, as lead or in alloys, and excludes second-hand material. Scrap lead also includes residues like slags and drosses. Secondary lead is the lead content reclaimed as metal or in alloys from scrap and residues. Scrap arises as storage-battery plates, pipe, cable sheathing, acid-chamber lining, shot, foil, type metals, solders, bearing alloys, and ammunition. Battery plates furnish about 50 per cent of the secondary lead, and cable and pipe are other large sources.

Figures and Facts

Statistics, presented in the accompanying table, bring out some noteworthy facts. The percentage that represents the relationship between secondary lead recovery and virgin lead consumption has risen steadily, and has been steeply accelerated since 1925. In 1920 the ratio was 23 lb. secondary lead recovered, and presumably re-consumed, to 100 lb. of virgin lead; in 1925, it had jumped to 35 per cent; in 1931 it shot up to 57 per cent; and in 1932 it skyrocketed to 73 per cent. These recovery figures are remarkable when it is remembered that lead in paint, running around 20 per cent of virgin consumption, is wholly lost.

Note, too, that lead recovered as lead—excluding that recovered in alloys—has averaged 50 per cent of the total secondary-lead recovery, and that since 1930 it has bulked even larger, touching 65 per cent in 1932. Significant also is the increasing share of the secondary lead recovered by the primary smelters. In 1920, primary smelters accounted for only 12 per cent of the secondary lead, but from 1928, through 1931, they have produced an average of 24 per cent; and it would be surprising if Bureau of Mines statistics, when available, do not show close to 50 per cent for 1932 and 1933. Noteworthy also is the fact that secondary lead recovered by primary smelters was only 3 per cent of virgin consumption in 1920, but that by 1931 it had risen to 14 per cent, and my estimate is that in 1932 the percentage was well over 30 per cent, and so far this year it has been even higher.

Rivalry

Comparative virgin and secondary lead statistics focus rather sharply the battle waged for scrap by primary-lead producers among themselves and with secondary refiners. First in the field were the secondary smelters. These comprise a score or so operating large well-equipped plants and hundreds doing little more than a remelting business. The keen rivalry of primary smelters became especially apparent when the custom smelters, American Metal in 1927, and American Smelting & Refining—the dominating factor in the lead market—in 1930, became active buyers of scrap, although the Western plants of the latter interest had used some scrap much before that date. And the struggle for scrap has naturally been accelerated in the past few years as abnormally low lead prices and decreasing ore imports have forced smelters to seek additional raw material.

Generally speaking, the secondary smelters produce and market the same line of lead and lead alloys sold by the primary smelters. Necessarily, the product of the remelter is not up to the quality of that produced by the smelter who operates a blast furnace, and the latter's product is below that of the secondary smelter operating a reverberatory. Operating costs may or may not be higher than those of the primary smelters, depending much on labor costs. Selling prices of secondary metal are generally lower than those of primary smelters, but are sometimes on a par. Thus, although large secondaries produce a soft lead, guaranteed 99.75 Pb, or even better, they may not be able to guarantee, say, the bismuth content, and

Relationship of U. S. Secondary Lead and Virgin Lead—In Short Tons

Year	(A) U. S. Virgin Lead Consumption	(B) U. S. Virgin Lead Production	(C) U. S. Refined Lead Production (Includes Foreign Ore)	(D) Total U. S. Secondary Lead Recovery	Percentages D÷A	Percentages D÷B	Percentages D÷C	(E) Secondary Recovery by Primary Smelters	(F) Secondary Recovery by Secondary Smelters	Percentages E÷A	Percentages E÷D	Percentages F÷A	(G) Secondary Recovery as Lead	(H) Secondary Lead Recovered in Alloys	Percentages G÷D	Percentages G÷A
1920	538,020	476,849	529,657	124,650	23	26	24	15,474	109,176	3	12	20	56,350	68,300	45	10
1921	444,872	398,222	448,589	103,780	23	26	23	16,831	86,949	4	15	19	46,370	57,410	45	10
1922	492,705	468,746	532,662	159,560	32	34	30	27,507	132,053	6	17	26	75,480	84,080	47	15
1923	573,543	543,841	618,322	194,490	34	36	31	39,198	155,292	7	20	27	96,430	98,060	49	17
1924	602,947	566,407	690,493	204,500	34	36	30	38,028	166,472	7	19	27	90,400	114,100	44	15
1925	655,655	654,921	766,969	226,880	35	35	30	44,629	182,251	7	20	28	112,420	114,460	50	19
1926	717,653	680,685	798,941	277,300	39	39	35	44,053	233,247	6	16	33	125,000	152,300	45	17
1927	662,973	668,320	796,530	276,300	42	41	35	47,277	229,023	7	17	35	119,000	157,000	43	18
1928	657,565	626,202	781,071	308,600	45	49	40	66,993	241,607	10	22	35	138,000	170,600	44	21
1929	692,765	672,498	772,633	311,000	45	46	40	81,051	229,949	12	26	33	138,500	172,500	44	20
1930	582,774	573,740	643,033	255,800	44	45	40	57,939	197,861	10	23	34	129,000	126,800	50	22
1931	410,606	390,260	442,764	234,700	57	59	53	57,947	176,753	14	25	43	128,800	105,900	55	31
1932	257,798	255,337	288,361	198,300	73	78	62	(a)	(a)	..	..	..	128,000	70,300	65	50
Totals	7,289,876	6,976,028	8,112,015	2,875,860				(b) 536,927	(b) 2,140,633				1,383,750	1,492,110		
Average	560,760	536,617	624,001	221,220	39	41	35	(b) 44,744	(b) 178,386	(b) 8	(b) 20	(b) 30	106,442	114,778	48	19

Tables drawn from Bureau of Mines publications. (a) Not available. (b) For 12 years (1920-1931) only.

such lead may sell at $3 per ton below refined lead guaranteed, for instance, to analyze up to A.S.T.M. specifications for desilvered lead. Obviously, such lower prices may not be without attraction for some consumers.

Although it is in soft lead, antimonial lead, and the alloys that most of the production of the secondaries lies, a few have marketed oxide leads, desilverized lead, chemical lead, and cable lead. On the kind of scrap used and the cost of refining or super-refining depends whether a secondary will produce such metal. No definite line as to where the market for primary metal ends and that for secondary begins can be drawn, as no definite distinction seems possible at times between a secondary smelter and a primary smelter using nearly all scrap.

The Focus

Around battery-plate metal, new and scrap, has revolved the struggle for supremacy among smelters. Storage-battery makers are the largest class of lead consumers, and the biggest part of their requirements — except for oxide metal—may be said to be met by metal refined from battery-plate scrap. At first it was the secondary smelter that met most of the demand for grid metal, but when the primary smelter began to use battery-plate scrap to make desilverized and other lead, he found himself a large producer of antimonial lead. And when the demand for batteries dropped in the past three years, and zinc and steel stampings began to replace antimonial lead for building ornaments and casket trimmings, antimonial lead, selling normally at a premium over refined lead, has sold at a discount. At the same time, as antimonial lead consumption dropped, secondary smelters took to producing relatively more soft lead.

One way in which the primary smelters have won in the struggle for scrap supplies has been by acquiring secondary plants. Another way has been by cutting the smelting or treatment charge on battery-plate scrap.

Battery-plate scrap has been, in the main, the fruit of 25 million United States families taking to the highways in automobiles. The life of the average battery has been figured in recent years at two to two and two-thirds years, and according to the latest A.B.M.S. study, the amount of lead in battery-plate scrap available in 1928 was 144,000 tons; in 1929, 153,000 tons; in 1930, 135,000 tons; in 1931, 125,000 tons; and in 1932, 108,000 tons. The estimate for 1932 is in close agreement with the actual battery-plate consumption as checked by Lead Industries Association for its membership. Considering these A.B.M.S. figures as actual production of lead from battery plates, this scrap alone accounted for 46 per cent of the total secondary lead recovery in 1928, 49 per cent in 1929, 53 per cent in 1930 and 1931, and around 55 per cent in 1932.

Battery plates are bought by the custom smelters, American Metal and American Smelting, and by other primary and secondary smelters, on the basis of the dry lead and antimony contents at the New York price for refined lead, generally on *E.&M.J. Metal and Mineral Markets* quotations, week of arrival of shipment or week after arrival, minus a smelting charge for treatment. Although some primary and secondary smelters buy plates at a flat price on clean, dry metallic basis, the actual price here also depends on the metallic content. New automobile battery plates may average around 93 Pb and 7 Sb, but scrap, when divested of wood, rubber, water, and electrolyte, and smelted, will net between 72 and 85 lead and antimony, but the average is nearer 73 to 75. The average battery weighs between 24 and 30 lb., and therefore nets about 17.5 to 22.5 lb. lead and antimony.

Only a few years ago, back in 1930, the smelting charge on battery-plate scrap was $28 per net ton for carload shipments, but the competition for the scrap by custom smelters and others, especially when Eagle-Picher entered the market on a large scale in 1932, drove the charge down to $13, and at this writing it is $19.50. At around $20 and higher for the treatment charge, the secondary smelter who uses a blast furnace and kettles to produce soft lead and must sell his antimonial slag to a primary refiner, may be considered a competitor for battery-plate scrap, but when the smelting charge is lower only large secondaries operating reverberatories find it possible to compete for scrap, especially when, as has happened in the past few years, the demand for antimonial lead has slumped. When demand for grid metal is good, the smaller secondary may be highly competitive at a smelting charge below $20.

An Index

The $15 drop in the smelting charge may be taken as a true mathematical index of the quickened demand for scrap in the past few years. Although it must be remembered that, with refined lead at 3c. to 4c., scrap offerings tended to be withheld from the market and that smelters' labor costs had also declined somewhat during the depression, nevertheless the three-quarter cent per pound drop in the smelting charge—and in the operating profit of the smelters—may be taken almost as full measure of the struggle for scrap supplies. Operating at a $13 to $14 smelting charge is hardly profitable even for the larger primary producers, but certainly producing lead from ore, and selling the lead on a 3c. market, entailed a larger loss, ran up virgin stocks, and still left available all the lead in scrap that was around. Scrap, too, was especially needed as smelters' receipts of ores dropped. Economically, scrap was more profitable even at a $13 smelting charge, certainly less unprofit-

able, than mining ore and producing virgin lead to sell at 3c.

Lead has paralleled copper in its increasing application in the electrical field, and secondary-lead scrap has paralleled secondary copper in its growing importance, but the influence of secondary lead on the refined-lead price has been much less obvious than that of secondary copper on the electrolytic copper market. For one thing, the lead market price has been dominated by one or two large producers, and the many conflicting interests of the copper market have been lacking. Despite this dominance, the lead price has been quick to reflect changes in the supply-and-demand relationship, and no producers' agreements have been made in an attempt to maintain an artificial price, as in the case of copper.

Scrap, therefore, has been spared the spectacular rôle of establishing a going market price for lead as it did at times for copper. Yet it must be obvious that a secondary-lead recovery equaling 50 to 70 per cent of the virgin consumption or production cannot but have a sharp, if subsurface, effect on the market price of primary-refined lead; especially since 50 to 65 per cent of the secondary-lead production (as much as half of the virgin consumption) is marketed and used as lead. Patently, too, custom smelters may overreach themselves on scrap, and the scrap intake may affect the lead price. In fact, this is known to have happened at times in the past year or so.

Powder Metallurgy

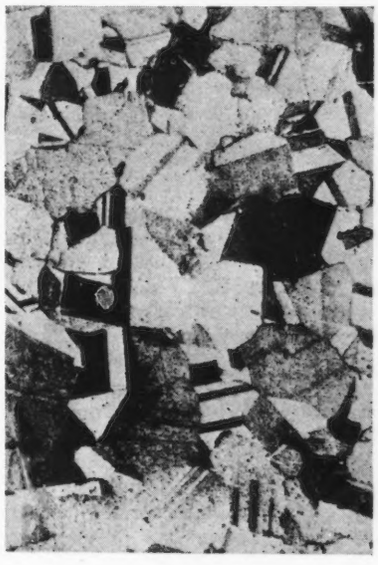
Competes Effectively with Smelting and Machining Processes

Charles Hardy

WHAT is frequently referred to as "powder metallurgy" had its beginnings at the turn of the century when the metals tungsten and molybdenum first became commercial commodities. Inasmuch as the melting points of these metals are 3,400 deg. C. and 2,620 deg. C., respectively, their production in refined form by pyrometallurgical procedure would have been exceedingly uneconomical. Some other method of making them was necessary. The two elements were therefore produced as metals by reducing their oxides with carbon, a tungsten powder or a molybdenum power resulting. These powders were then, by various methods, compressed into slabs or bars, with or without a binder; heat-treated, and subsequently worked into sheets and wires without ever reaching anywhere near their respective melting points. The drawing of tungsten bars into lamp filaments is the best and most familiar example of this procedure. Since the first steps were taken in this direction powder metallurgy has developed at an ever-increasing rate.

Definition

At this point a definition is in order. As referred to in this article and others which I have written, powder metallurgy is the art of producing metals in finely divided form, the metals so produced being then subjected to mechanical treatment to give them a final or semi-final shape without the aid of the orthodox methods of smelting and machining. Thus defined, powder metallurgy has important advantages in allowing the production of finished machine parts without waste; and in permitting the combination of metals and non-metals and the production of compounds of various elements not readily alloyed in furnace or crucible. Solid solutions, as also the compacting of the various component parts, are almost invariably obtained at temperatures lying below the melting temperature of the respective metals or alloys. Should a reader think it wasteful to powder metal, only to convert it into a solid form again, let him ponder on the foregoing points as well as on the fact that the powdered metals, when compressed and heat-treated, possess unique and useful properties that justify the method of procedure involved in applying the art.



Photomicrograph of a 65-35 brass made by reconsolidation of metal powders

The Powders

To describe in detail the methods employed for powdering metals and for compressing them in various mixtures, with subsequent or simultaneous heat-treatment, into finished parts or other objects would prolong this article beyond available space, at the same time retracing ground already covered.[1] As for the work of powdering, let it suffice to say that the metals used may be brought into this state by various means, depending on the metal. These include the grinding of ingots; the reduction of the purified oxide of the metal in a proper atmosphere; distillation and subsequent condensation; pouring a thin stream of metal through a strong air blast; and, finally, and of great importance, the process of depositing pulverulent metal directly by electrolysis. Bismuth, cadmium, chromium, copper, iron, molybdenum, nickel, silver, tin, tungsten, and zinc are produced commercially in powder form today. The electrolytic process involves the manipulation of conditions in the electrolytic tank so as to bring down a spongy deposit, which, on being washed, reduces to an impalpable powder with gentle rubbing. Thus produced, the metal powder is then sized by screening and bolting. The powder thus prepared consists of roughly shaped angular particles that are superior for compression purposes because they readily interlock with each other because of their angularity, the strength of the joint between adjacent particles proving greater than the strength of the individual particle, as can easily be demonstrated.

That the preparation of the metal powder is the most important part of the art of powder metallurgy is a conclusion readily reached from the foregoing as well as subsequent considerations. Most powders are produced today in a purity certainly not less than that of the best refined metals, having the advantage of the absence of oxides, sul-

[1] Cf, "Manufacture and Use of Powdered Metals." Charles Hardy. *Metal Progress*, July, 1932.

phides, and, through the process of drying at elevated temperatures, the physical characteristic of limiting grain growths to a very small percentage.

Compressing the Powders

The reconsolidation of metal powders into useful shapes—which is perhaps the most pregnant development of the art at the present time—is accomplished by filling a suitable mold with the desired mixture of powders, squeezing it, as by a plunger working in a cylinder, until the particles cohere, and then heat-treating the compressed powder until the particles weld together at points of contact. This heat-treatment will cause small changes in size, which can be allowed for in advance. For such procedure, the particles should be not only angular shaped, as previously said, but should be free of oxide on the contact surfaces which would prevent the intergrowth or welding of crystals when they touch each other. In a number of applications metal powders are now compressed and heat-treated simultaneously, a process which greatly reduces the amount of pressure needed and allows a closer approach to the density equivalent of cast or forged metals. Tungsten carbides are invariably so produced.

Ordinarily, the amount of compression used exceeds 5,000 lb. per square inch, the pressure determining the density of the finished material. The density of the powder, to start with, is of the greatest importance because it determines the application to which it may be put. If we take an average density, say that of copper powder at 2.75, a compression in the ratio of 3 to 1 would give us a metal with a density of 8.25, or the approximate equivalent of the density of cast copper, which is 8.3-8.4. Evidently, if the powder has a density of only 1, a filling space 8 in. long would be required to make a 1-in. briquet. Thus, in the press used for reconsolidating the powder, the press opening for filling space plus plunger will assume proportions that are hard to imagine if pieces larger than 1 in. are to be made. Therefore, if a powder having a density of 4 instead of 1 be used, the filling space need be only one-quarter as long.

Furthermore, in compressing such a light powder, the amount of air entrapped during compression would result either in a very laminated briquet, or would create a distributed porosity interfering with the physical properties of the resulting briquet. An additional point here to be considered is the friction of the powder against the side of the die: this will be increased as the distance the plunger travels from the top of the filling space increases.

Effect on Tensile Strength

Reference to the drawing of tungsten bars into lamp filaments was made in the opening paragraph. It is interesting to know that the greatest tensile strengths per square inch ever determined for any metal or compound metal were obtained in a tungsten wire produced from a metal bar made from powder. Moreover, bronze wires have been drawn with a tensile strength 30 or 40 per cent greater than that of wires of like composition made from wire bars. The explanation is to be found in the fact that the art of powder metallurgy allows a predetermined grain size, absence of gases, avoidance of oxides at the grain boundaries, and the interlocking at the boundaries of the particles by reason of the angular structure of the latter. As previously explained, this interlocking accounts for the fact that the crystals in a wire will themselves break before they will pull apart from each other.

Porosity and Oilless Bearings

A great advantage of powder metallurgy is that by its means finished parts having a predetermined porosity can be made. Thus, compressed metals for making bearings and bushings may be produced having an oil absorption to meet the user's requirements. In a recent test, a bar made from 80 parts copper, 10 parts tin, 10 zinc, and 2 graphite showed an average oil absorption of 14.3 per cent by volume and 1.86 per cent by weight. Of a total porosity of 17.4 per cent, 14.3 was available. Thus 82 per cent of the total was used.

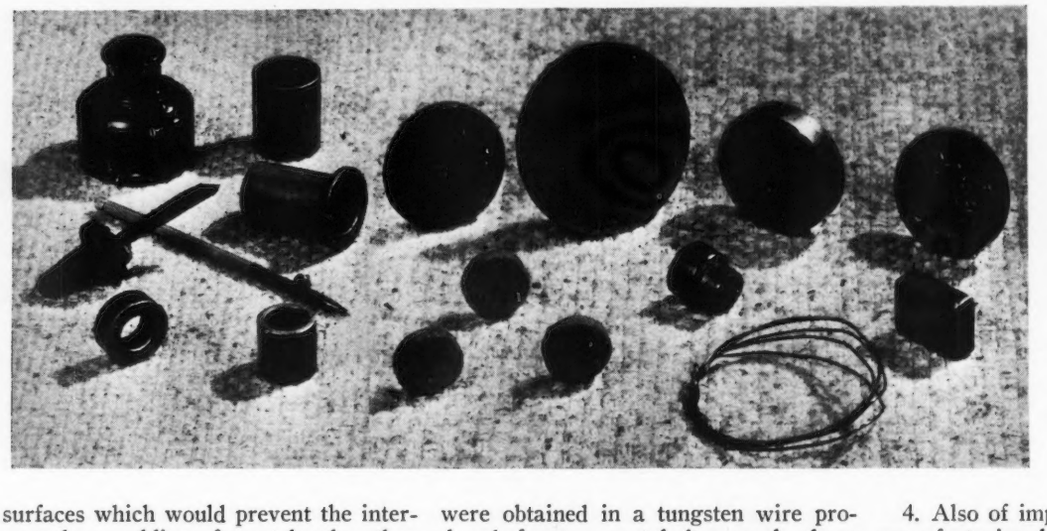
Advantages

Advantages of reconsolidated or compressed metals may be summarized:

1. Porosity and grain size are under control.

2. Metal of highest purity and alloys of constant composition are produced. Likewise, alloys and mixtures of metals that either cannot be mixed as liquids or have widely different melting points. Likewise mixtures of metals and nonmetals, as, for example, copper and graphite, for making generator brushes, and tungsten and carbon, to form tungsten carbide.

3. An important advantage is that the size of the finished part or object may be held to close limits, so that it competes easily with the best die castings.



Some of the many articles and parts made by the art of powder metallurgy

4. Also of importance is the fact that manufacturing losses are small. There is no loss from slagging, from cropping or oxidation, or from trimming.

Many of the applications of powder metallurgy have already been indicated, directly or indirectly. One of the more recent is in the production of welding and brazing rods by extrusion. This is very promising, inasmuch as it allows the production in bars and rods of metals which are so brittle that they could not be drawn in the ordinary way. Rods having definitely defined welding temperatures can be produced, because by varying the compounds entering into the rods, a given welding temperature can be achieved.

Of the combination of metals and nonmetals previously referred to, the best example is the one already mentioned of tungsten and carbon, forming tungsten carbide for high-speed tools. Of late, nickel and cement have been combined in spark plugs to increase the resistivity. Copper and porcelain have likewise been combined to give a resistivity of 140, as compared with 100 for Nichrome. Contact points of varying compositions, especially tungsten and silver and tungsten and molybdenum, are in constant use.

Mining Asbestos in U.S.S.R.

Transition from Hand Operations to Mechanized Production Accomplishes Aim of Five-Year Plan

Walter A. RuKeyser

IN A PREVIOUS ARTICLE *(E.& M.J., August, 1933, p. 335)* I described the occurrence and geology of the most important chrysotile asbestos deposits of the Soviet Union, located at Bajenova, in the Ural district. In this, the second of a series of three articles on these deposits, the methods used in mining, past and present, will be described. In August, 1929, when I first visited the district, I found the methods of mining in a state of transition. I was thus present during the period between old hand production and the highly mechanized state of efficiency which was the objective of the Five-Year Plan in this industry.

The thinness of overburden which characterizes these deposits has been previously mentioned. Consequently, there was and is little need for mechanical methods of removal. This is in direct contrast with the Canadian deposits. In the latter, where the overburden exists at its maximum depth of, say, 120 ft., power shovels found excellent application and even hydraulic stripping was employed. In the deposits at Asbest (the name by which the Russian mining community is known), the deposits have been stripped by pick-and-shovel loading into horse-drawn wagons. Only during my sojourn in the Urals, when power shovels were recommended and purchased for mining operations, was the overburden stripped mechanically, due to the availability of the equipment for its major purpose.

The year 1929 saw about twelve thousand workers with their families (totaling possibly 40,000 people) living either in large log barracks or in hovels as illustrated in Fig. 1. In contrast to these conditions, Fig. 2 shows a group of houses built for the technical and executive staff, which, by 1931, saw a complete housing program finished on a new townsite for the entire population. The map, Fig. 3, shows the conception of this plan in 1929 with the townsite located south, west, and northwest of the lake which forms the major topographical feature of the locality. Asbest in 1931 boasted of a main hospital with 120 beds, with four other minor "clinics," numerous schools, including a secondary trade school accommodating 1,200 pupils, a "house of culture" covering an ordinary city square block, a geological museum, and a hotel of some pretension. Sociologically, at least, the Five-Year Plan was well consummated at these mines and resulted in tremendous improvement over the former standard of living of the workers.

Figs. 1 and 2—Contrast in living quarters at Asbest, 1929-31

Completion of the narrow-gage railway from Asbest to the Trans-Siberian Railway at Bajenova in 1927 made possible the intensive development of the mines and the building of what is today a modern mining community. This railroad, 34 km. in length, in my opinion represented a tremendous piece of false economy. Its gage as well as that of the entire ore-handling system at the mines was set at 600 mm. As the Russian gage is larger than the standard—namely 1.5 m.—the building of this narrow-gage connection to the Trans-Siberian Railway necessitated, first, the reloading of all imported heavy equipment and machinery at the border from the Continental European railways to the standard Soviet lines, and, second, rehandling at Bajenova. The congestion at the latter point during the mechanization of mining and milling methods can well be imagined; and the same applies to the shipping of the finished product, practically all of which must go over this Trans-Siberian Railway. The terrain over which the narrow-gage runs is comparatively flat and provides a maximum grade of 3 per cent for but 1 km. The fact that the railway and mine transport are actually one system gave rise to the necessity for building special equipment throughout and was one of the distinct problems with which I had to cope in attempting to lay out plans for the large-scale development of these deposits. It imposed a practical limitation of 30 tons for locomotive work and required special construction for all 5- and 10-ton cars as well as steam and electric locomotives suitable for the work involved. Capital costs were thus greatly increased.

In 1931 the railway commissariat

This is the second of three articles by Mr. RuKeyser on the Bajenova district. The first pertains to geology, the second to mining, and the third to milling.

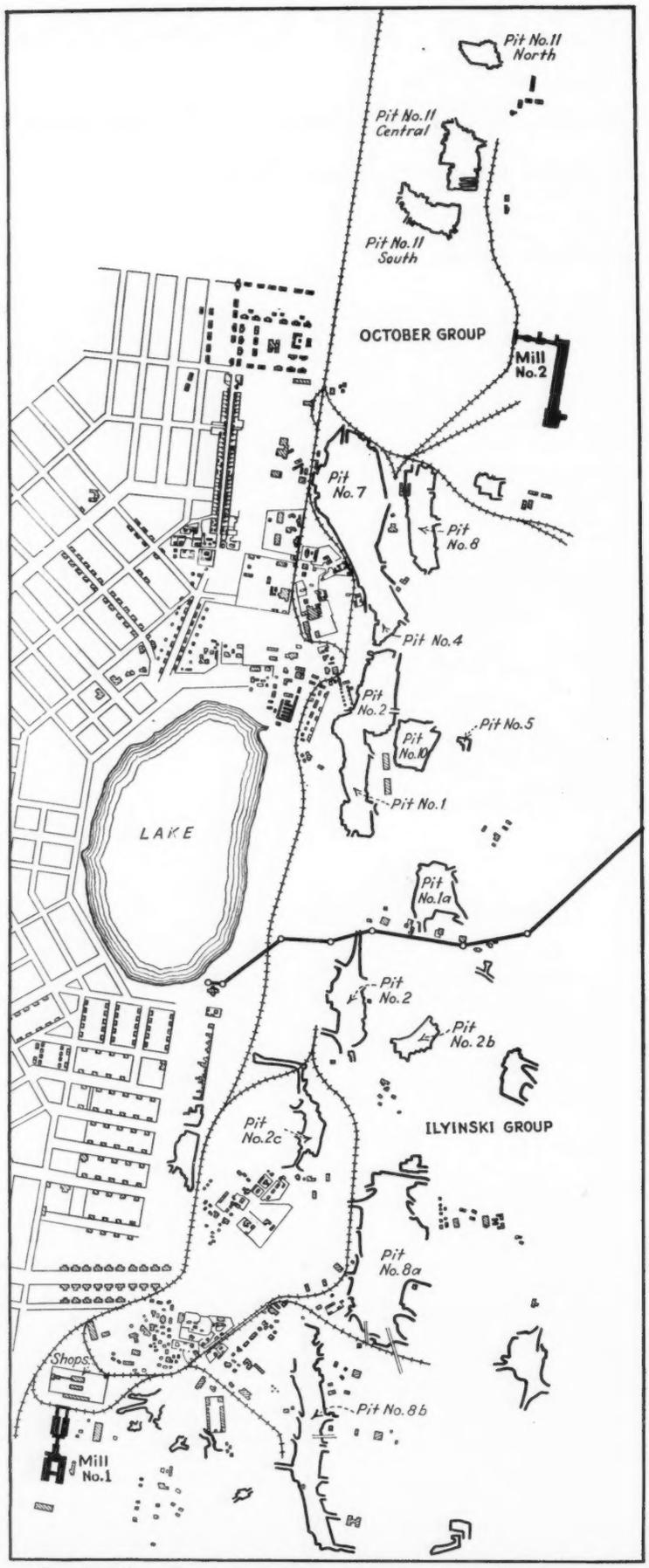


Fig. 3—Pits, mills, and townsite. Site of proposed Mill No. 3 is half way between Pit No. 5 and right edge of map.

located a new line between the mines at Asbest directly southwest to Sverdlovsk, eliminating Bajenova entirely. This road was to be standard Russian gage. However, at the time of my leaving the work in 1931 this new road had not been commenced.

The following figures pertaining to the railroad operation may prove of interest. For the fiscal year 1927-28 it cost 4 rubles per ton to transport 37,875 tons miscellaneous freight 36 km. In 1928-29 the cost was 3 rubles 57 kopeks for 57,082 tons, and in 1929-30, 2 rubles 98 kopeks for 94,789 tons.

(Note: One ruble is approximately 50c. at par, the gold rate of exchange at that time averaging 1.94 rubles to the American dollar; 100 kopeks=1 ruble.) The following table shows the transport of ore over the system for the same years.

	Tons	Ton-Km.	Kopeks per Ton
1927-28	252,000	378,871	34.1
1927-28	727,630	989,500	19.7
1929-30	1,609,848	2,229,929	17.0

As of September, 1930, approximately 573 men were employed daily on the transportation system, including shops and superintendence. Since the five-day week was then in vogue, this meant that approximately 400 hands were actually at work on the transportation system, about one-fifth always having their day off and the remainder being on the sick list or not working for other reasons. In addition to the miscellaneous freight and ore mentioned in the foregoing, the transportation system handled 13,106 passengers in 1927-28; 85,809 in 1928-29, and 147,911 in 1929-30. The minimum passengers carried was for the month of December—namely, 5,779; the maximum in July, 20,187, clearly indicating the high rate of labor turnover.

The mine haulage system, both underground and on the surface, was being electrified at the time of my leaving, the work having commenced in 1929. This electrification was proceeding very slowly, due to the retarded rate of development of the main power plant producing electrical energy at Egorshino, which lies approximately 66 km. north and slightly east of Asbest. It is interesting to note that although the Canadian mines enjoy comparatively cheap hydro-electric energy, the deposits at Bajenova have equal if not superior advantage in that the power source is located at the pit head of a substantial deposit of subanthracite coal. This was charged by the Power Trust to Uralasbest at 4 kopeks per kw.-hr. The plan called for the development of 36,000 kw. in the plant at Egorshino in the ultimate electrification of townsite, mines, mills, and transport system. The influence and limitations imposed by this factor on the development of the deposits during my contract with them will be discussed later.

In October, 1930, the transport equip-

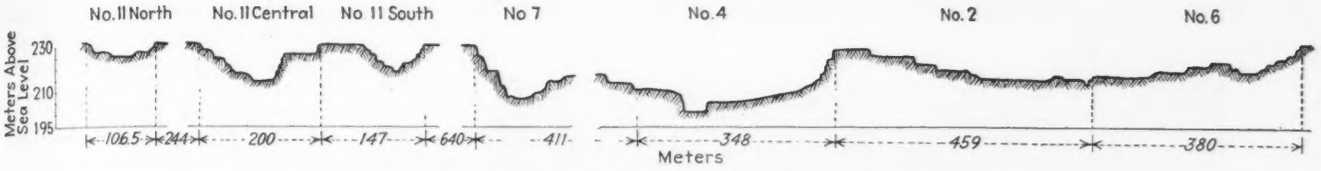


Fig. 3a—North-south longitudinal section, October group. After P. M. Tatarinov.

ment consisted of 135 10-ton cars, with 186 additional on order in 1931. There were 21 steam locomotives on hand at that time, of which two were 30-ton, 220 hp.; 8 were 15-ton, 90 hp.; and the others of smaller miscellaneous weights and horsepower. There were 14 15-ton 90-hp. on order for 1931. In addition, there were on hand two electric locomotives, with six on order. All were of German (Koppel) make.

The productive zone at Asbest, extending as it does for 21 km. in a north-south trend, has given rise to an almost unbroken series of open-cut workings originally developed by private owners before the revolution. A reference to the map, Fig. 3, shows more than twenty major pits, with numerous other smaller ones which are of no present significance. Since the entire district is now administered by the single State Trust, Uralasbest, many of the former separate workings have been consolidated. The major operations fall into three groups. The most northerly, not shown on the map and at present of lesser importance, is known as the Proletariat. This produces shorts almost exclusively.

The two major producing groups that are now being intensively developed are known as the October (or central) and the Ilyinski (or southern). The October group comprises pits known as 11 North, Central, and South, three workings which are to be consolidated into one operation if my plans are followed. These three pits lent themselves extremely well to electric-shovel mining under a partial spiral system. The most important mines of the October group on which development has proceeded farthest are known as pits Nos. 7 and 8. Number 7 also merges into No. 4. To the south of and separated from No. 4 by a comparatively narrow strip of lean rock (possibly 50 m. wide), are pits Nos. 2, 5, 1, and 6, now known simply as No. 2 and No. 1 of the October group. To the east of No. 2, and separated by a dike of aplite of an average thickness of approximately 50 m., is pit No. 10, also of the same group. Fig 3a shows a longitudinal section through October group. Something less than half a kilometer to the south is the first open-cut mine of the Ilyinski group, known as pit No. 2, with two smaller operations to the east and to the southwest, known respectively as 2B and 2C. The largest two workings of the Ilyinski group begin approximately half a kilometer south of No. 2 and are known as Nos. 8A and 8B, the latter being offset from the former to the southwest by a zone of lean material something less than 200 m. in width. For all practical purposes we can limit our description to October Nos. 11, 7, and 8 and to Ilyinski Nos. 2, 8A, and 8B.

At the time of my first arrival in the district, in 1929, practically the only phase of the mining operations at all mechanized was the drilling. To understand the mining methods then in use it is necessary first to explain what I am pleased to call the semi-mechanical methods of extraction used in the mills, although this phase of the subject will be thoroughly discussed in the next article. It is necessary to point out here that the mills from which practically the entire Russian production came, up to and including 1930, were, in the most cases, 20 or 30 years old. They were built at a time when the only transportation to the Trans-Siberian Railroad was by horse. Furthermore, the only power available was from small, individual, wood-burning steam plants. These old Russian mills, therefore, had adopted processes involving a minimum of heavy machinery which would have to be hauled in by wagon and a minimum of energy input. Coupled to this was a plenitude of cheap, if unskilled, labor, with a further consideration that the markets for which the product was intended desired the fiber in as unopened or "crudy" a state as possible.

Because these small mills were thus of necessity so limited in capacity, what may be called a rough concentrate was produced by hand labor in the mines. The material that went to the mills ran from 20 to 25 per cent asbestos content, the average being 22 per cent. Only

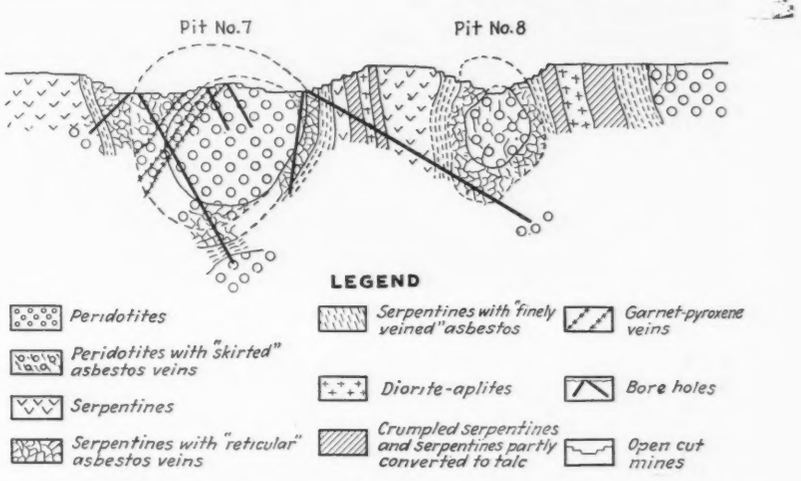


Fig. 4—Cross-section through pits Nos. 7 and 8, October group

Figs. 5 and 6—Hand operations and wagon transport, 1929

Fig. 7—Ilyinski No. 8, transition to mechanized mining

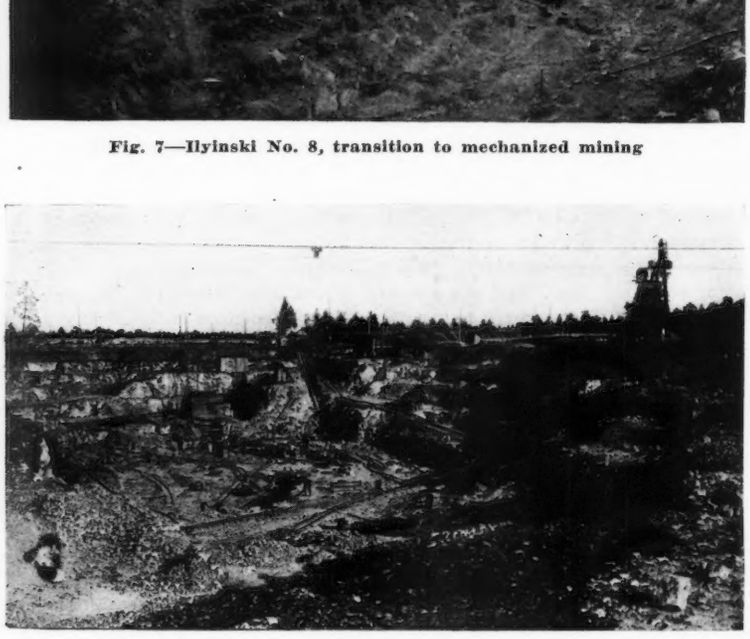


Fig. 8—Cableway and haulage plane, Ilyinski No. 2, 1929

Fig. 9—Hand operations, Ilyinski No. 2, 1929

lump crudes and grades I to V were produced. Therefore, mining methods were introduced that obviated sending the entire run-of-mine rock to the mills. Only one-quarter or one-fifth of the mined material was transported to the plants for further treatment by methods that will be described later. Canada, enjoying, as it does, a near-by and considerable market for its shorts, has during the growth of its industry required large-scale methods of both mining and milling, involving the sending of practically the entire run-of-mine to the mills for the extraction of a last fraction of a per cent of the short grades. This factor did not enter into the previous situation in working Ural deposits.

The mining methods, past and present, used in the Bajenova district were further dictated by the peculiarities of the geology, described in the previous article. The cross-section through pits Nos. 7 and 8 of the October group, Fig. 4, clearly shows the factors and limitations imposed by the geology in the selection of mining methods. Figs. 5 and 6 show operations in pit No. 8 in the fall of 1929. The rock was drilled with light Flottmanns in benches of from 2 to 3 m. It was then broken down and sorted by hand, the crudes being cobbed therefrom, the rejects being put over screens moved around from place to place in the pit. The waste rock was hauled to dumps by the wagons shown in the foreground. Often the veins of asbestos were dug directly from the ground by pick and the material was thrown directly over the screen. Fig. 7 shows No. 8 Ilyinski during the transition period attendant upon mechanization. The small benches characterizing the former hand methods are clearly discernible.

The year 1929 saw the introduction of moderate-speed Bleichert 2-ton cableways shown in the picture of pit No. 2 Ilyinski, Fig. 8. The comparatively small capacity of these cableways militated against eventual large production with that equipment. A 4-ton cableway was later installed at No. 11 October. Furthermore, the boxes were of wood and unlined, often resulting in the contamination of the asbestos with wood splinters. Attendant upon the installation of these cableways, which in every case utilized the fixed foot-tower and movable head-tower, inclined haulage-planes were installed with electric hoists. The deepening operation then consisted of driving a central channel longitudinally along the deposit. The height of the benches was increased to 5 and 6 m. and the cableway boxes were loaded by hand as shown in Fig. 9, the operators classifying the material into crudes, mill feed, and waste rock. In 1930 the boxes at No. 11 were loaded by electric shovel. Several benches were worked consecutively. Fig. 10 shows the head-tower and surface loading bins, one for waste, one for mill feed, at No. 8 Ilyinski.

At the beginning of the intensive mechanization in 1929, the greatest depths attained in the October group were as follows (ground surface at the edge of the pits having an average elevation of approximately 230 m. above sea level): pit No. 11, 17 m.; No. 7, 23 m.; No. 3, 29 m.; Nos. 1 and 2, 16 m.; No. 6, 11 m. In the Ilyinski group, pit No. 2 had a depth of approximately 25 m.; No. 8, 35 m.

In 1928, the erection of a mill was commenced, to have a capacity of 2,400 tons of rock a day. This is known as Mill No. 2, but more commonly as the "Gigant," or Giant. It is located off the productive zone to the east and approximately halfway between October pits Nos. 7 and 11. This mill burned to the ground in May, 1929, before completion. It was immediately reconstructed and was finally put into intermittent operation in the summer of 1930. It will be described in the next article. It was directly after the burning of this plant in 1929 that I was first called to Russia

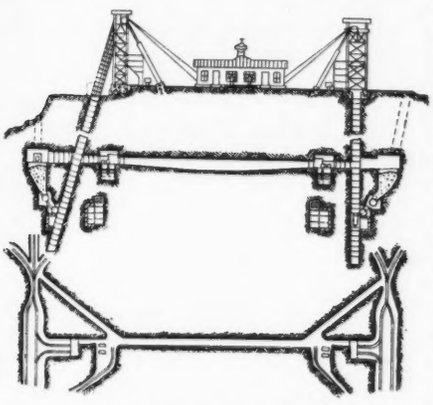


Fig. 11—Section and plan, underground workings at pits Nos. 7 and 8

in a consulting capacity. Coincident with the building of this plant, plans had been worked out for the large-scale operation of pits Nos. 7, 8, and 11. I reached Asbest practically at the completion of the installation of systems of mining that had been determined upon before I was called into the work. In the zone of barren serpentine separating No. 7 and No. 8, two shafts had been sunk to serve a proposed glory-hole system of mining, the development work for which was at that time nearing completion. Shaft No. 1, which was to serve mine No. 7, was inclined at 75 deg. Shaft No. 2, to accommodate ore from mine No. 8, was vertical. The main haulage level was at 50 m. A glance at the geological section, Fig. 4, will show why these shafts were driven as they were and will locate them in connection with the underground stations and connections shown in Fig. 11. The compressors as well as both hoists were housed in the buildings shown between the two headframes. Both the shafts were equipped by the German firm of Humboldt and each was to have a capacity of 2,000 tons of rock per day.

The minable area around the island of peridotite in No. 7 had been laid out into some 30 cones apexing in raises 3x3 m., through which the ore was to be drawn into the main haulageway for transportation to the shaft bin underground, thence to be hoisted to the surface in 5-ton skips.

Underground work was divided into three shifts: 6 a.m. to 1 p.m., with an hour out between 9 and 10 for lunch; 3 p.m. to 9 p.m., and 11 p.m. to 5 a.m. The six-hour working day was prescribed at Asbest by the Labor Union as opposed to seven hours in the open-cut workings and in the mills. Underground work was served by two 5-ton electric locomotives capable of hauling eight to ten 5-ton cars at the grade, which was set at .002. Although shaft No. 1 was operating at the time I finally left the district in 1931, its capacity never reached the rated 2,000 tons. From 1,300 to 1,500 tons a day apparently taxed its capacity. Mines Nos. 7 and 8 were served by two Ingersoll-Rand compressors, one unit delivering 44 cu.m. per min. of free air, the other 36. Seventy Flottmann sinkers were in use, capable of drilling holes up to 6 m., cleaning by air, not water. There were eleven 5-ton cars underground of the type shown in Fig. 12. With the exception of the compressors, all the equipment was of German manufacture. The raises in pit No. 8 were to have been finished in December, 1930.

The illustration of the headframe, Fig. 13, is typical of Russian construction, possibly necessitated by the low strength of the yellow pine available in that district.

During the latter part of 1929 a feeble attempt was made at mining from the first glory hole which had been started. The sides of the glory holes were to have been carried between 45 and 50 deg. The top of the raise into which the glory hole discharged was fitted with a rail grizzly with 500-mm. openings. Several of the raises so equipped were being used at that time merely to draw off rock from the open-cut workings, the rock being trammed to them by horses in 1½-ton cars as shown in Fig. 14. Pit No. 7 was also served by the inclined haulage-plane shown in Fig. 15, located at the north end of the pit. This had a capacity of 400 tons per day with the hoist then installed and 1½-ton cars on 6-lb. rails.

Although I was told that over 6,000,000 rubles had been expended on the more than 4 km. of underground development, after an intensive study of the problems involved, I was amazed that a glory-hole system should ever have been proposed for pits Nos. 7 and 8. In my reports to the Trust, which were later read and debated before the Supreme Council of District Economy at Sverdlovsk, and finally again at a session before the National Technical Council in Leningrad, which lasted several days, I recommended that glory-

Fig. 10—Head tower and loading bins, Ilyinski No. 8

holing be abandoned and simple power-shovel methods employed in open-cut mining. Among my reasons for this were the following: (1) The deepest level to which mining had already progressed was only 25 m. (2) This 24-m. bench, already developed, was served by transport to the inclined plane and also to the raises already broken through from the underground haulageways, and afforded an adequate immediate working face for shovels. (3) The experience with the one hole already commenced showed that a major portion of the time was lost by the stopers due to the large amount of bulldozing required on the grizzly. (4) The 45-deg. slopes became extremely dangerous under winter conditions of ice and snow. Should this be to some extent offset by the proposal which was made to carry the sides of the holes in the form of a series of terraces, then any possible advantages of glory-holing would be eliminated. There would again be shallow drilling, high explosive costs, hand-shoveling, and related factors. (5) Due to the hygroscopic nature of asbestos rock, coupled with the drainage from the pits, the rock would freeze solidly in the raises during the winter. This was actually the experience later in attempting subsequent operation. (6) An enormous quantity of water was made underground, there being apparently some subterranean fracture connecting the lake and the shafts. (7) Each shaft was equipped with only one underground bin, thereby preventing efficient handling of waste rock as opposed to ore, unless each shaft were to be devoted entirely to one purpose. (8) When the glory holes completely bottomed to the main haulage level the rock left between the cones would present a serious problem in reclaiming. (9) It

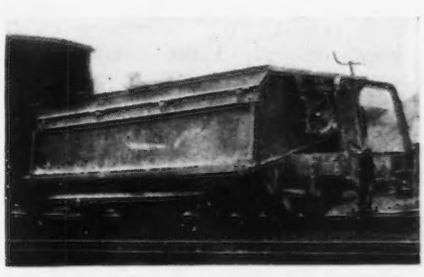


Fig. 12—Five-ton cars for underground haulage

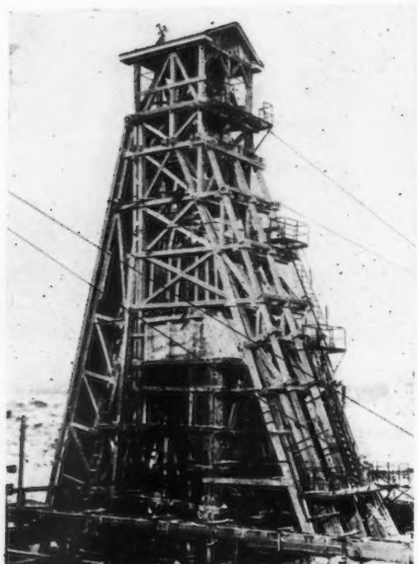


Fig. 13—Headframe construction of yellow pine

seemed unnecessary to take rock from a 25-m. depth, drop it to 60 or 70 m., and then hoist it back to the surface. (10) Utilizing deep drilling with heavy, mounted drills, the 24-m. bench could be cheaply drilled and blasted in either one or two lifts, any large rock thus produced being easily handled by power shovels dumping direct into 5- or 10-ton cars, transported to the inclined plane by locomotives, and hoisted up the plane to the surface transport system. I therefore recommended such methods. These were favorably accepted because of their simplicity, the cheapness of the ore produced, the immediate accessibility of the ore, and the ability to feed the mill, if need be, from this one working face alone.

Two electric shovels had already been purchased and were on the ground. Their intended use was the reclaiming of a large stockpile of broken ore which had been built up for the new mill. Although the buckets were only 1½ cu.m., and the shovels were entirely a.c. equipped (Menck-Hambrock, Germany), as opposed to the more efficient d.c.-a.c. (it being remembered that electric energy was at a premium), I recommended immediately taking one of the shovels into pit No. 7, Fig. 15. No drills were available for holes deeper than 5 m. Therefore, to test out the ideas involved, particularly in drilling high benches, the executives of the Trust decided to use diamond drills temporarily. The holes were sprung with 40 per cent ammonal and later blasted with 60 per cent dynamite. This had too great a shattering effect, but was all that could be supplied to the Trust.

Whereas the former method of working produced approximately one ton of ore per man-shift, the daily report for October 13, 1930, showed 1,703 tons with 276 men (including all workers, pit, transport, surface and underground at No. 7). This was 98.2 per cent of the plan for that day as to tonnage, with only 69 per cent of the labor provided under the plan for that operation. When it is remembered that the working day is seven hours, as opposed to ten in Canada, and that owing to the five-day week over one-fifth of the number of employees mentioned in the foregoing were idle, the apparent production of 6.1 tons of rock per man-shift is increased to practically double, or 12 tons per man. The efficiency of this method as compared with that achieved by the use of cableways is readily observed in the report for pit No. 8 Ilyinski on the same day. Where the plan called for 435 tons of mill feed, only 88 tons was produced, or 20.2 per cent of the plan, utilizing 43 men. This gave a little over two tons per man-shift. Further, it must be remembered that the shovel had only a 1½-cu.m. bucket and at the time was still loading into 1½-ton cars. No locomotives were available in the pit, and the incline could handle only 400 tons, the other 1,300 having to be dropped through the raises, trammed to the shafts, and hoisted. With a shovel of suitable size, loading into 10-ton cars, and the incline supplied with the large hoist which could readily be spared from shaft No. 2, the ability of this one working face to take care of the entire capacity of the new mill No. 2, without any recourse to mines Nos. 8 or 11, becomes obvious. (All tonnages referred to in the foregoing are in metric tons.) Since the shafts were already completed and equipped, I recommended the use of shaft No. 1 to hoist rock from a system of shrinkage stopes, to be developed to mine the extremely narrow but rich body of rock southerly in pit No. 4.

The major untouched productive zone available for the continuation of power-shovel operations in pit No. 7, without taking another lift beyond the 25-m. depth already attained, extends from the west-central portion of No. 7 underneath the old townsite and old mill No. 1, running into pit No. 2 to the south. It comes into this at the point where the west side of the pit is shown in Fig. 3, bellying out at its juncture with No. 1. This provided a large ore reserve for mill No. 2 should the ore go to that plant from this one working only.

I had proposed the ultimate elimination of the newly installed 2- and 4-ton cableways at No. 11. In my opinion the geology and the dimensions were such as to make this operation ideally suited for shovel operation. Shovels could load into 10-ton cars with locomotive haulage direct to the mill bins. The suitability of this method was enhanced by the fact that in October, 1929, the depth (maximum) of No. 11 north was from 5 to 7 m., the central 15 to 17 m., and the southern pit 10 to 12 m., permitting a spiral of easy grade to enter from the surface at the northeast corner of the northernmost pit, attaining depth through the virgin ground to the west of the central pit, turning east at the grade of the southern pit, and going north downward into the bottom of the central. This recommendation was also approved by the National Technical Council in Leningrad after a detailed study of the data and a lengthy debate as to feasibility, costs, and potential production. The detailed plans for the installation of this system were drawn up under my direction before my departure after my second sojourn in the district in 1930-1931.

On the map, to the right of Pit No. 5, a mill site had been proposed, to be known as No. 3, with a daily rock capacity in 21 hours of 6,000 metric tons. The location of this mill had been determined before I was called into consultation. The site had already been cleared and several hundred thousand rubles spent in the preliminary work and in building such auxiliaries as fire control. It was proposed to serve this mill by surface transport and inclined tunnel, through which rock from pits Nos. 1, 2, and 10 would be hauled. The mining was to be done by power shovels working in the face of rock at the west-central portion of pit No. 2, with another shovel in No. 10. Eventually, pits 1, 2, and 7 would have been one large open-cut almost 1½ km. in length. This plan would afford a maximum of control in selection of types of ore for the purpose of keeping mill feed constant, or for making any selection of rock dictated by changing market requirements. Just before my departure in 1931, and after the previous approval of the plans for these operations, including shrinkage stoping of the narrow portion of the orebody on pit No. 1 at a subsequent date, I was informed that the new mill was to be located to the west of pit No. 7. This appeared a logical decision, as I had questioned the previous location on several occa-

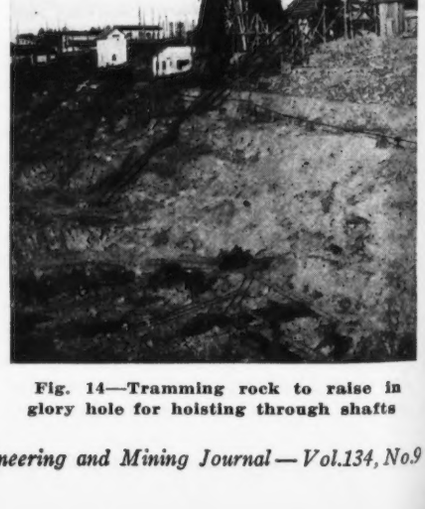


Fig. 14—Tramming rock to raise in glory hole for hoisting through shafts

sions. This new mill, No. 3, was to have been finished in 1931, but I am told was put into intermittent production only this year. It evidently had been adequately proved that power-shovel mining in the October pits could be so developed in conjunction either with inclined plane or inclined tunnel haulage as to more than take care of even the 6,000 tons of rock per day required to feed this mill. Further, it must also have been demonstrated that pit No. 11 alone could, with the same methods, take care of the requirements for mill No. 2 ("Gigant"). In October, 1930, five electric shovels were on the ground, three on order and six for 1931; all, in my opinion unfortunately, of the same size and weight as the originals.

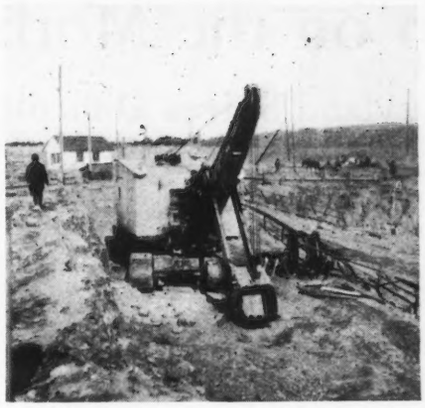


Fig. 15—Stripping overburden with electric shovel

The mining cost per ton of asbestos in the district as of October, 1929, was 74 rubles 88 kopeks. Since the extraction at that time was only 2.2 per cent, this would give a mining (only) cost of approximately 1.5 rubles per ton of rock, or a little over 75c. per metric ton with the ruble at par. Mining cost in October, 1930, for the shovel material for pit No. 7, according to the best figures I had compiled, was a little less than 40 kopeks per ton of rock mined (direct labor, supplies, and power delivered at the surface).

In the next and last article of this series I shall describe the treatment of the rock from the production in the mine, of what I am pleased to call the concentrates, to the production of finished product in the mill proper.

The Penrose Bequest and the G. S. A.

OUT of many suggestions received by officers of the Geological Society of America as to what should be done with the $4,000,000 bequeathed the Society early in 1932 by the late R. A. F. Penrose, Jr., a definite plan, marked by conservatism, was devised after long consideration and has now been in effect for some time. The task was not easy, according to Dr. Charles P. Berkey, secretary of the Society. The responsibility for handling such a large sum wisely and in accord with the evident wishes of the donor was as great as it was unusual, for rarely is a scientific society forced to concern itself with financial matters of such magnitude.

The plan, as devised, contemplates the use of income only, the principal sum remaining intact. The income will be in hand before any project is undertaken. As now invested, the principal is yielding in the neighborhood of $150,000 or better per annum. Out of this has been set aside in 1933 the sum of $100,000 to furnish the otherwise unsupplied backing for the XVI International Geological Congress, recently held in the United States, with its headquarters in Washington. Without this aid, the Congress could not have been held here this year. The Geological Society of America had been the leader in proposing that it be held in this country and persuaded other bodies to cooperate. Owing to economic conditions, however, adequate financial support was wanting. Private subscriptions from individuals or organizations were not forthcoming. So the Society stepped in. In making the Congress feasible this year, it felt, says Dr. Berkey, that it was rendering the best geological service possible. The amount thus set aside was to be drawn upon for the necessary official expenses and to ease the general cost of excursions. Thus the Congress was put on practically the same footing as it has had when convened abroad, in countries where government subsidies have taken care of the major expenses. This has been the Society's first adventure in financing, and by far the largest for a single object thus far considered.

This activity is of course one that the Society will not be called upon to repeat. Aside from such special instances, the plan for using the income of the bequest contemplates two fields in which effort will be sustained. These are publishing and research.

In the past the Society has limited its publishing activities to producing its Bulletin—a quarterly. In the future, this will appear six times a year, without change in size and format but with such improvements as the inclusion of maps and use of better illustrations. The number of pages per issue will be increased as desired. In addition, to take care of papers that the Society formerly felt itself unable to publish because of their length, a series of so-called Memoirs has been established. These will include individual papers and reports, which will be published, in bound form, as books. Of them there will be about six per year, the number however being left indeterminate.

A Bibliographical Index of Foreign Geological Literature is also to be published by the Society. This will appear annually, the first probably by the end of 1933, collection of material for it having been started last January. This index will parallel and supplement that of the Bibliography of North American Geology, produced annually by the U. S. Geological Survey and directed by John M. Nickles, who has now been taken over by the Geological Society and who will supervise the new venture.

Disbursements for research are being made circumspectly and in the direction of rendering possible the completion of projects undertaken by various institutions that found themselves unable to continue to provide the necessary funds. The Society has persuaded the geologists so engaged to state their needs and make suggestions. Its Council then decides which of these projects it can properly aid and to what extent. Occasionally an entirely new project may be originated. The Society is not contemplating institutional aid in any way, however, or supporting fellowships, organizations or other publications. Instead, it prefers individual or group grants quite independent of the control of other organizations, so as to avoid the danger of interfering with somebody else's burden or program. It does not wish to become committed to work that may continue for years and tie up funds indefinitely.

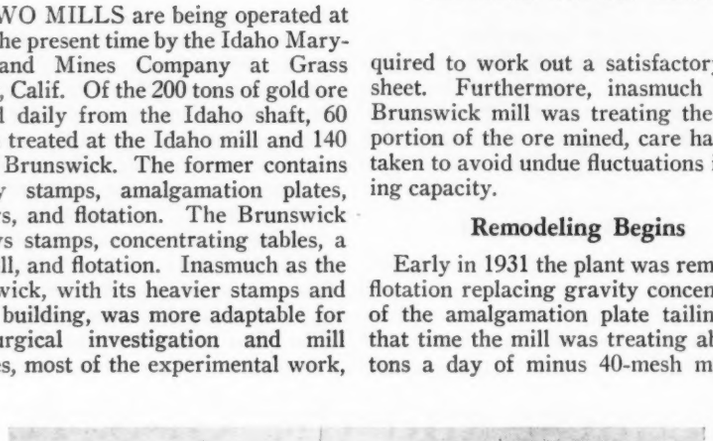
Research projects selected by the Council up to July 1 last are twenty-two in number. The financial aid thus granted amounts to $30,619. The largest sum given is $5,000, the smallest $125. Of the projects, perhaps the most interesting are those of the Yellowstone-Beartooth-Bighorn areal work in the United States (W. T. Thom, Jr.), which has been under way for several years, and the geophysical research being carried on at Harvard University (Donald H. McLaughlin). The rest vary widely, including among others a study of the Algerial coastal ranges; the Hoover Dam reservoir survey; and studies respectively of the Tertiary faunas of northern Mexico, of climatic processes affecting erosion and denudation, and of Devonian corals.

Flotation on the Mother Lode

Idaho Maryland Solves Difficult Problem

Ernest Wm. Ellis

TWO MILLS are being operated at the present time by the Idaho Maryland Mines Company at Grass Valley, Calif. Of the 200 tons of gold ore hoisted daily from the Idaho shaft, 60 tons is treated at the Idaho mill and 140 at the Brunswick. The former contains gravity stamps, amalgamation plates, vanners, and flotation. The Brunswick employs stamps, concentrating tables, a ball mill, and flotation. Inasmuch as the Brunswick, with its heavier stamps and larger building, was more adaptable for metallurgical investigation and mill changes, most of the experimental work, incidental to the development of the flowsheet, was carried on at this plant.



Idaho Maryland's Brunswick mill

The orebodies at the Idaho mine occur in or adjacent to a serpentine belt. Consequently, a large quantity of primary slime—a result of movements along the vein in the serpentine—accompanies the quartz ore, which requires skillful handling underground and on the surface, as well as special milling treatment. The ore is not duplicated in the district. Gold, most of it free, is the valuable metal content in addition to some silver. Sulphide is less than 1 per cent by weight of the total ore. Pyrite is the chief value-bearing sulphide, followed by galena and by selenium and tellurium compounds such as naumanite and petzite, which occur in small quantities. This latter group, including the galena, are high grade and have to be reckoned with in milling. Chalcopyrite is present in varying amounts.

Investigation showed that even after grinding to 1,600 mesh some values were still locked up. Because of this as well as the many modes of occurrence of the gold, some of which is undoubtedly colloidal, and because of the large amount of slime present, considerable time was required to work out a satisfactory flowsheet. Furthermore, inasmuch as the Brunswick mill was treating the larger portion of the ore mined, care had to be taken to avoid undue fluctuations in milling capacity.

Remodeling Begins

Early in 1931 the plant was remodeled, flotation replacing gravity concentration of the amalgamation plate tailing. At that time the mill was treating about 75 tons a day of minus 40-mesh material. The flotation machine used was of the air-Ventura type, the air being supplied by a blower. A large portion of the primary slime was roughed out by a Dorr thickener and sent to waste. Efforts were made to prevent loss of an appreciable amount of barren slime, because the smallest tonnage overflowing the thickener would assay from $2.50 to $3.50 a ton. The flotation tailing passed over a Deister table, which acted as a pilot and simultaneously removed any sulphide too coarse to float. With this flowsheet the flotation recovery was about 50 per cent and the total mill recovery about 85 per cent.

Flotation Cell Changed

Experience soon showed that a mechanical type of flotation machine was needed for treating this type of ore. Accordingly, a six-cell Kraut rougher and a two-cell cleaner were substituted for the air cells. Next, the roughing-out process was abandoned and all feed sent direct to the Kraut cells. This called for a reagent set-up that would depress the slimes, as extremely fine sheathing of the colloidal material would armor the float bubbles and prevent the value-bearing particles from adhering to the froth, thus causing an immediate drop in recovery. Various slime depressants were used, such as starch, glue, sodium silicate and others, to overcome this difficulty. No conclusive results were attained. Finally, a compound was developed at the laboratory which consisted partly of starch, but which in no way resembles ordinary starch solution. For want of a better name, however, this reagent is called "starch." Use of this solution bettered conditions materially, but not to the extent desired. A long exhaustive campaign of experimentation in which only one variable would play a part at a time thus began. The ore, which varies considerably in value and mineral content, had to be accepted as mined. On the other hand, the circuit density, the pH of the pulp, the tonnage, and numerous reagents with their countless set-ups, had to be tested by experiment. Careful notes were kept, automatic samplers installed, and a system of sample preparation, assaying methods, and fluxes was developed. In this manner the flotation recovery was raised from 50 per cent to 78 per cent.

Fine Grinding

The next step was to install a ball mill. Two 7x12-ft. Worthington units were purchased, one of which was reduced to 7x5 ft. Power is furnished by a 125-hp. synchronous motor equipped with a multiple V-belt drive. A 6-ft. Dorr duplex classifier was installed in closed circuit with the mill. Operation of both units began early in February, 1932. The classifier also contains an elevated V-box for roughing out the slime water, which is used for washing the sand from the classifier to the mill and the mill discharge to the classifier. Addition of fresh water is thus avoided, with consequent lowering of circuit density. A sized ball load was added and the amount kept down because of the small tonnage the ball mill would have to handle at the start. High-carbon chrome-steel liners are used. Liner consumption has not been yet determined, because the original liners are still in use. A small raised backing around the bolt holes permits a wash back of the liners and reduces the amount of gold locked up in the mill. In fact, more gold is deposited in the scoop and discharge boxes and in the classifier than in the ball mill. The boxes are cleaned periodically. Ball consumption is about 1.8 lb. per ton. Two 5-in. balls are added each shift.

Next in order of change came the raising of the mill tonnage. Two questions had to be studied before this could be done: First, what tonnage could be sup-

plied the mill, and, second, what percentage of gold should remain for the ball mill to release before flotation? To handle the designated tonnage, a size of screen too coarse for amalgamation would eventually be reached. This called for tabling the free gold. All changes were made without interfering with milling. Advantage was taken of the two clean-up days each month. For instance, a Deister table was installed between the plates and the classifier so that the feed of one stamp battery could be run onto the table and the table tailing flow by gravity to the classifier. The gold streak, galena, and tellurides were conveyed by a system of water control and a cutter riffle to a small bin, prior to batch amalgamation. The rest of the sulphides, middling, and tailing were sent to the ball mill. This made it possible to remove the plates in front of ten stamps and to install a table on the plate floor. From these stamps the feed was then sent to the new table and the product of the second set of stamps directed to the lower table. The second set of plates were removed next and a second table installed on the plate floor.

Stamp Screens Replaced

Ultimately, the 40-mesh screens on the battery mortars were replaced by 8-mesh Tyler Ton-Cap screens with 0.07-in. openings, which raised mill capacity from 75 to 140 tons a day, or 70 tons per table. This was insufficient, however, to build a bank of sulphides on each table that would permit a good separation of the coarse, flat grains of gold from them. No difficulty was experienced in separating the fine gold. This inconvenience was overcome by directing all sulphides from the two tables treating the battery product, to the table which had been used temporarily while equipment was being changed. Obviously, this table became a permanent part of the flowsheet, treating sulphides and free gold exclusively. The gold and high-gravity sulphides cut off it daily are taken to the amalgamating room, where the free gold is amalgamated in revolving pans containing two or three large steel balls. Clean sulphides are shipped to the smelter. The second cut from the table may be passed to flotation for stabilizing the froth or be shipped to the smelter direct. The latter course is now being pursued. The feed delivered to all tables is unclassified.

The present mill flowsheet—a result of the research work described — consumes in all 275 hp. Investigation was continued to determine the best reagent set-up, circuit density, desirable feed, pH of circuit, and other phases that would improve recovery. The feed to the ball mill is ground to about 5 per cent plus 100 mesh. A screen analysis of the classifier overflow or flotation feed is as given in the accompanying table.

Screen Analysis of Flotation Feed

− 48	+ 65 mesh	0.44
− 65	+ 100 mesh	5.30
−100	+ 150 mesh	14.14
−150	+ 200 mesh	13.12
−200		67.00
		100.00

In view of the values locked up in the tailing, the question naturally arises whether or not the present grind is fine enough to insure maximum recovery. Laboratory investigation shows the loss curve almost horizontal in the fine sizes. Values locked up in material as fine as 1,600 mesh would probably be lost despite separation from the gangue. If it be assumed that these values might be released, other fines would probably be produced which would perhaps offset the expected gain.

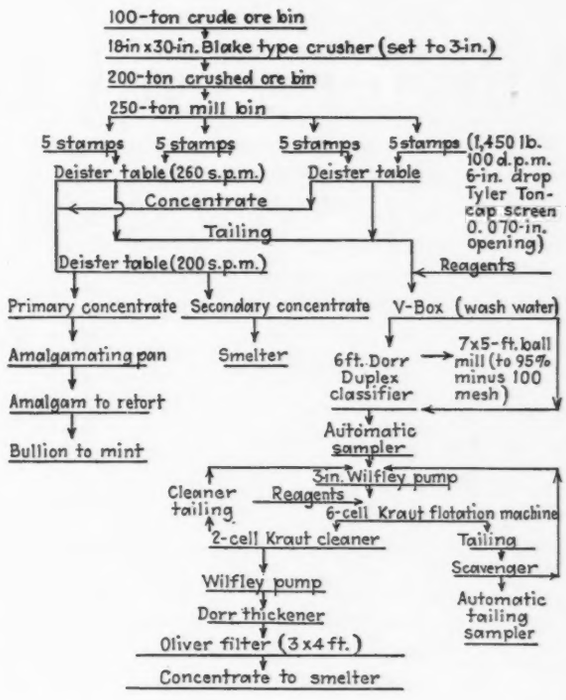
The pH of the circuit averages around 9. Circuit density may vary from 15 to 25 without affecting recovery appreciably. With the high slime feed 140 tons of ore a day proved too much for the six cells, especially when richer ore was treated. The recovery is maintained by re-treating the flotation tailing in two small scavenger cells. Present plans include the possible installation of additional flotation equipment.

In regard to reagents, the method employed at the Brunswick mill is interesting in two respects. One is the development of a reagent feeder which offers rapid and positive control of the slime depressant, and the other is the maintenance of a definite texture of froth which the operator must learn to recognize and strive for if conditions become upset.

About 140 tons of $15 ore is being treated daily at present. Ratio of concentration is approximately 100:1. More than 50 per cent of the values contained is recovered as bullion. The remainder is in the flotation concentrate, secondary table concentrate, and primary concentrate. The latter represents the first cut taken from the gold table after the free gold has been removed.

Mill recovery is 96.25 per cent, 3.75 per cent being lost in the tailing. About half of these values in the tailing are locked up, the other half being extremely fine to colloidal free gold, or sulphide. Losses of free values are so small that even very careful panning will fail to separate values that would lower the tailing. Possibly a small part of these values may be economically recovered by increasing the flotation capacity.

Flowsheet of Brunswick mill

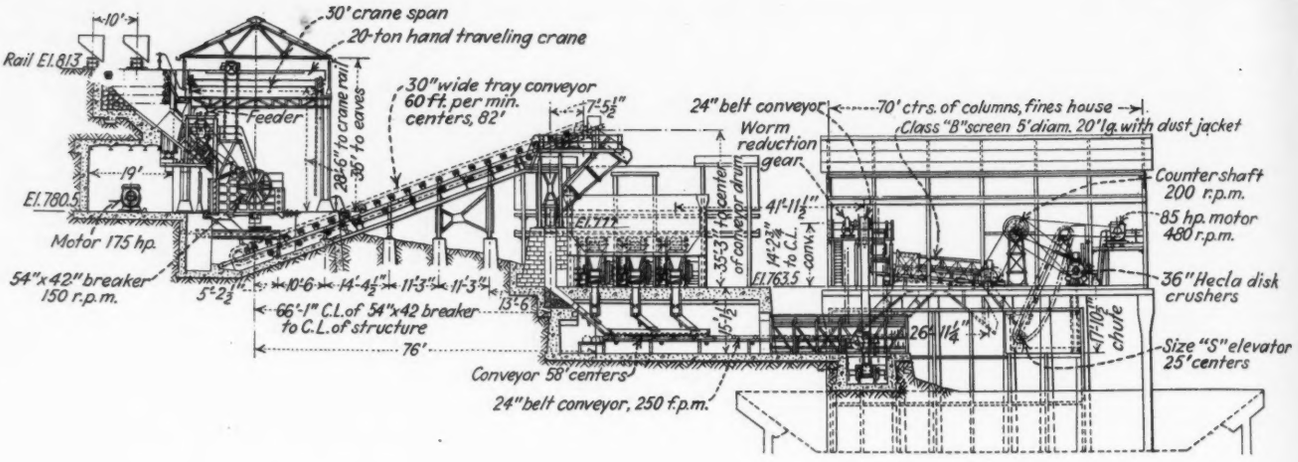


An Efficient Stemming Mixture

THE British Mines Department recently demonstrated at a quarry at Morriston, Swansea, Wales, the superiority of a new stemming mixture, developed to take the place of the clay ordinarily used. It consists of 75 per cent of gritty sand, 25 per cent clay, and a small amount of calcium chloride, which attracts moisture from the air and maintains a desirable dampness.

Tellurides

W. E. Johnston, author of the article entitled "Tellurides—Problem or Alibi?" which appeared in the August issue, has informed the Editor that in each of the tables presented in that article the figures in the third column, headed "Gold in Tails, %," do not represent the assay of the tails, as one might infer, but instead the percentage of the original gold remaining in the tails.



Efficient and Economical Crushed-Stone Production

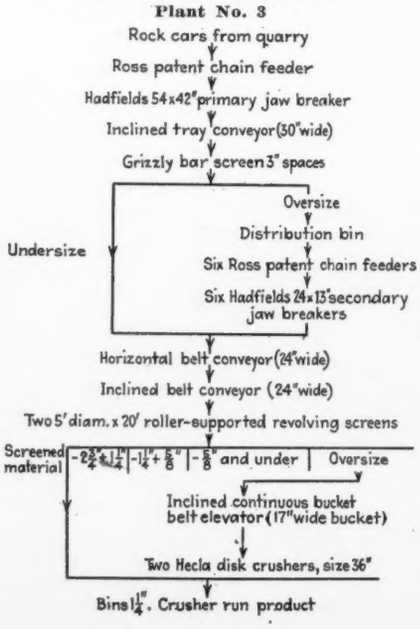
Sir Robert Hadfield

Bart., M. Inst. C.E., F.R.S.,
Chairman, Hadfields, Ltd.,
Sheffield, England

Successful building of a great dam involves the application of a high order of engineering skill and experience; but these requirements are equally necessary in the preparation of the materials of which the structure is composed. This article—by an engineer of international distinction, who has made significant contributions to the metallurgy of steel, and thus to the perfecting of design of large-scale milling plants—describes one of three crushing and screening units erected near the site, to supply the needs of the contractors engaged in building the Mettur dam, to hold back the waters of the Cauvery River, at a point 180 miles southwest of Madras, India. The reservoir thus to be formed, with a peripheral length of about 100 miles, will be one of the three largest of its kind in the world. The dam proper, now approaching completion, will be 5,300 ft. long and 176 ft. wide, representing over 10 million cubic yards of masonry, comprising rubble in cement with a concrete facing. Estimated cost of the entire Mettur project—for irrigation, power supply, and flood control in an area of great potential industrial importance—is expected to exceed £5,000,000 sterling.—EDITOR.

THE crushing, screening, and delivery plants, three in number, at the Mettur dam, Madras, India, are of particular interest because they represent latest practice in large equipment and economical design for the reduction of rock for construction purposes. Raw material, in the form of granite, is delivered to Unit No. 3, to be described in this article, by side-tipping trucks each with a capacity of 3 cu.yd., to a bin, and thence, under control of Ross chain feeders, to a 54x42-in. Hadfield crusher, with a capacity of 200 tons per hour. Its wearing parts are of Hadfield Era manganese steel, shafts of No. 37 Hecla steel, and sides and ends of toughened steel. The machine, which is set to crush to 6 in., weighs 100 tons, and is driven by a 175-hp. motor. Grease-pressure lubrication is used.

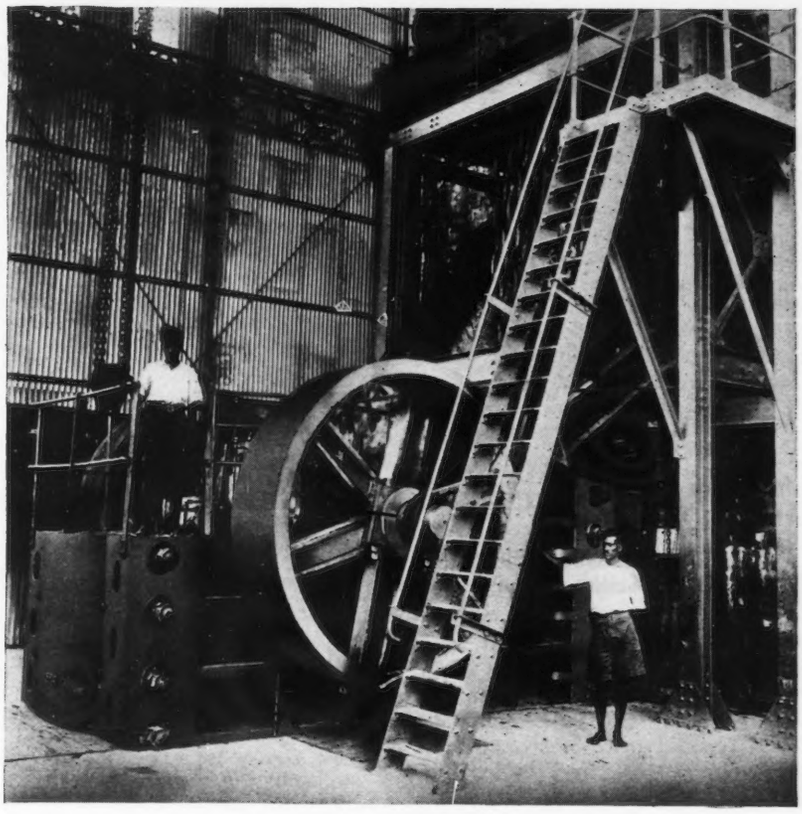
Flow Sheet of Cauvery Mettur Plant No. 3

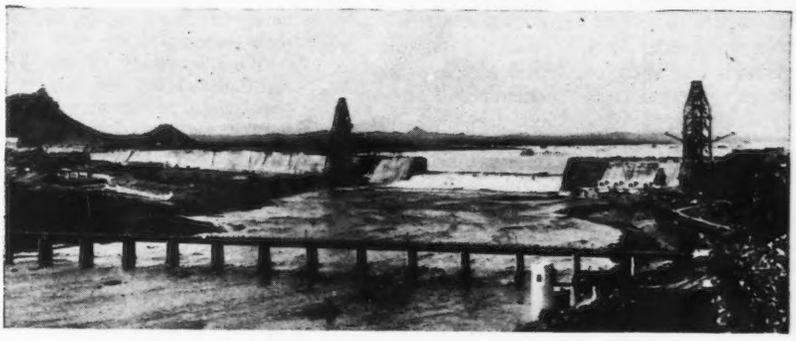

Rock cars from quarry
Ross patent chain feeder
Hadfields 54x42" primary jaw breaker
Inclined tray conveyor (30" wide)
Grizzly bar screen 3" spaces
Oversize
Distribution bin
Undersize
Six Ross patent chain feeders
Six Hadfields 24x13" secondary jaw breakers
Horizontal belt conveyor (24" wide)
Inclined belt conveyor (24" wide)
Two 5' diam. x 20' roller-supported revolving screens
Screened material
-2½" & 1½" | -1½" + ⅝" | -⅝" and under | Oversize
Inclined continuous bucket belt elevator (17" wide bucket)
Two Hecla disk crushers, size 36"
Bins 1¼". Crusher run product

Undersize from the primary crusher passes by gravity chute to a 30x8-in. tray conveyor, 82 ft. long, traveling at 60 ft. per minute and driven by motor through worm-reduction gear, and is delivered to a grizzly bar screen, 5 ft. 6 in. x 4 ft., with 3-in. openings. The oversize from this grizzly goes to a bin, from which it is distributed, through six Ross chain feeders, to six Hadfield 24x13-in. secondary jaw breakers, the product of which, together with the undersize from the grizzly referred to above, drops to a 24-in. horizontal belt conveyor, 58 ft. long, traveling at 250 ft. per minute, from which it is elevated, by another 24-in. belt conveyor, to two 5x20-ft. trommel screens, roller sup-

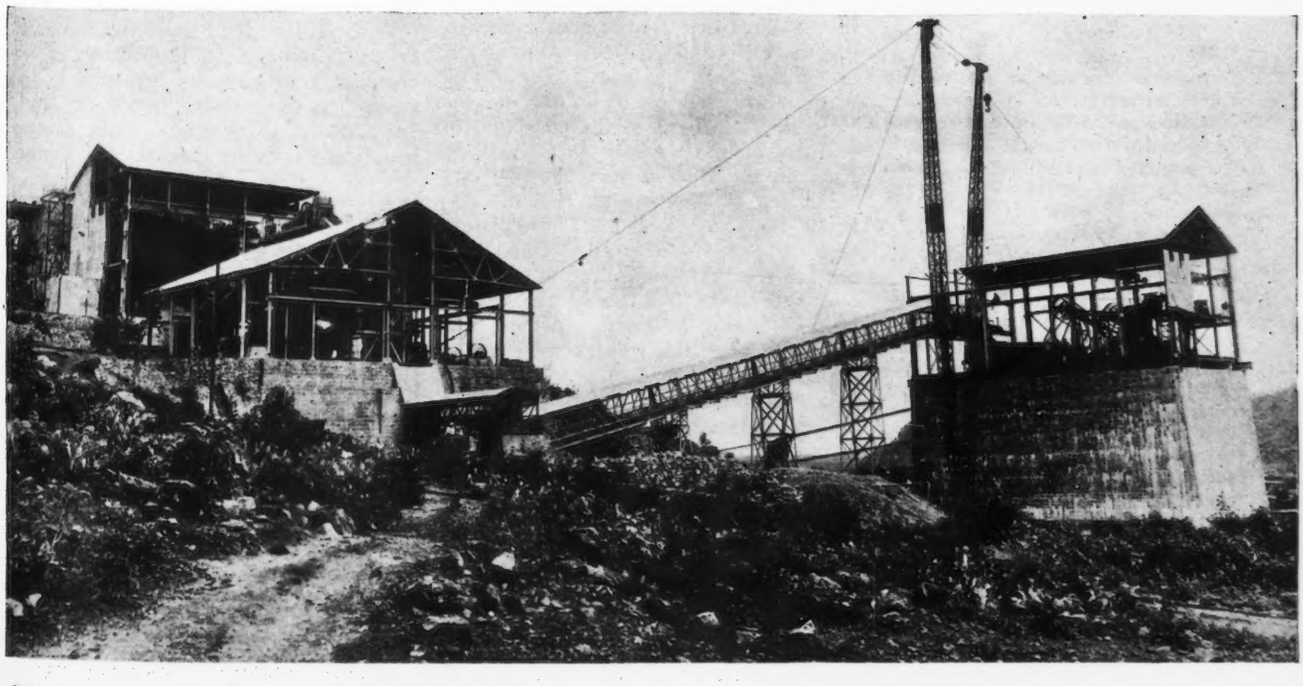
ported, making four products—minus $2\frac{3}{4}$ in. plus $1\frac{1}{4}$ in.; minus $1\frac{1}{4}$ in. plus $\frac{5}{8}$ in.; minus $\frac{5}{8}$ in.; and plus $2\frac{3}{4}$ in. This oversize product, the last mentioned, goes by conveyor with 17-in. buckets, to two Hecla disk crushers, delivering a $1\frac{1}{4}$-in. product to one of four compartments of a 1,700-ton bin, the other three compartments of which receive the products from the trommel screens, as enumerated above.

Motor capacity of this unit of the three Hadfields plants at Mettur is 642 hp. Output capacity of crushed and graded stone has always exceeded requirements and specifications, leaving ample time for maintaining the installation in a highly efficient operating condition. Of significance is the fact that the equipment in the three units was manufactured by Hadfields from special steel made in their Sheffield works; and that the Hadfield company was responsible for the design, erection, and trial operation of the plants in India before they were handed over to the government contractors three years ago, when the project was begun. Its successful completion in 1934 will provide new data on which similar engineering works, perhaps in isolated regions, may be undertaken with confidence as to ultimate result and over-all costs.





Above, Large primary crusher
Below, One complete crushing unit
Right, Mettur dam under construction



Trends and Developments In the Industry

Gold Producers Obtain Export Privilege

President Roosevelt Issues Order Permitting Sale of Bullion on World Market Through Secretary of Treasury, Subject to Latter's Rulings and Regulations

MODIFICATION of the embargo on newly mined gold to permit its restricted sale and export at the world market price was announced in an executive order by President Roosevelt on Aug. 29. By virtue of this order, it immediately became possible for gold producers in the United States to obtain for their bullion not already sold whatever price was obtainable abroad, less such incidental expenses as shipping costs and insurance. They must deliver such bullion, however, to the Secretary of the Treasury on consignment for sale, subject to whatever rules, regulations and conditions he may prescribe. Such sales must be made at a price which the Secretary shall determine to be the best obtainable, and this determination must be accepted by the producers as conclusive. The text of the President's order, save for the introductory paragraph, follows:

> "The Secretary of the Treasury is herely authorized to receive on consignment for sale, subject to such rules and regulations and upon such conditions as he shall prescribe, gold recovered from natural deposits in the United States or any place subject to the jurisdiction thereof. Sales may be made:
>
> "(a) to persons licensed to acquire gold for use in the arts, industries or professions, or
>
> "(b) by export to foreign purchasers.
>
> "Such sales shall be made at a price which the Secretary shall determine to be equal to the best price obtainable in the free gold markets of the world after taking into consideration any incidental expenses such as shipping costs and insurance.
>
> "Such sales may be made through the Federal Reserve banks or such other agents as the Secretary may from time to time designate and shall be subject to such charges as the Secretary may from time to time in his judgment determine.
>
> "Every person depositing gold for sale as provided herein shall be deemed to have agreed to accept as conclusive, without any right of recourse or review, the determination of the Secretary or his duly authorized agents as to the amount due such person as a result of any sale.
>
> "Consignments shall be sold as nearly as may be in the order of their receipt.
>
> "The Secretary of the Treasury, in his discretion and subject to such regulations as he may prescribe, is hereby authorized to issue licenses permitting the export of articles fabricated from gold sold pursuant to this executive order.
>
> "This executive order may be modified or revoked at any time."

A decisive step toward obtaining the full world price for their product had been made in August by representatives of the gold-mining industry through agitation at Washington which resulted in the Treasury Department authorizing the export of gold ore, concentrate, precipitate and amalgam. The ruling was telegraphed on Aug. 12 by the Bureau of Customs to the collectors of customs at the various ports, and on Aug. 15 the Bureau sent out two circular letters instructing customs officials how to proceed. These letters seem to comprise the only official record of the Treasury's recent rulings, now superseded, relative to the export of gold-mining products. Almost immediately after the rulings were made, the movement abroad of precipitate and amalgam began, the majority of the earlier shipments going to London through various banking agencies for the account of gold producers. Presumably such shipments ceased with the promulgation of the President's latest order, as it will undoubtedly be more advantageous for producers to ship their bullion under the conditions now prescribed.

Prior to the issuance of the President's order, steps were taken, it is understood, to arrange for the sale of United States gold-mine products through Canadian channels. Under the new changed conditions, the Secretary of the Treasury will decide how such marketing is to be conducted.

In the various gold-mining districts, developments of the last month have served to stimulate further the activity reported in July, as indicated in the following paragraphs.

California

With the completion of unwatering operations in the reopened shaft at the Bullion mine, near Grass Valley, activities are now centered in construction of surface buildings and erection of mining machinery. A 90-ft. headframe is being erected on the west side of the highway, with adjoining buildings to house the compressor equipment, a 100-hp. double-drum hoist, and the blacksmith and general repair shops. An overhead structure spanning the highway at a height of 65 ft. will carry the mined ore to the processing plant. The structure will be completely enclosed to assure safety from falling débris in transit.

A. G. Isling, Inc., operating the King Solomon mine, near Randsburg, is increasing mill capacity by adding ten stamps to the present five-stamp unit. In addition to the mill work a new headframe is being erected at the mine.

World Production of Gold

(American Bureau of Metal Statistics)

In Fine Ounces

1933:	May	June	July
United States (*a*)	185,000	142,000	176,000
Canada	238,000	240,000	243,000
Mexico	50,000	(*f*) 50,000	(*f*) 50,000
South America	63,000	64,000	68,000
British India (*e*)	27,000	26,000	28,000
Japan (*e*)	36,000	36,000	36,000
Australia (*b*)	94,000	98,000	97,000
South Africa	944,000	919,000	924,000
Belgian Congo	21,000	22,000	22,000
Rhodesia	53,000	54,000	54,000
British West Africa	29,000	28,000	29,000
Russia (*c*)	(*f*) 160,000	(*f*) 160,000	(*f*) 160,000
Elsewhere (*d*)	(*f*) 75,000	(*f*) 75,000	(*f*) 75,000
Totals	1,975,000	1,914,000	1,962,000

(*a*) Includes Philippines. (*b*) Includes New Zealand and New Guinea. (*c*) Chiefly Siberia; 1933 estimated at average rate of 1932. (*d*) Includes West Indies, Central America, Europe, and Asiatic and African lands not separately reported; estimated. (*e*) Principal mines; nearly complete. (*f*) Conjectural.

Discovery of a new orebody in the Beebe mine, near Georgetown, was announced by the management of Atolia Syndicate. The ore was uncovered on the 250-ft. level, and represents a considerable increase in available ore reserves. The mill is operated steadily on ores mined from the Beebe, Eureka-Woodside, and Alpine properties.

Preliminary to operations on a large scale, the King C. Gillette interests, of Los Angeles, are repairing the Breece and Wheeler ditch at the Paragon hydraulic mine, near Forest Hill. The ditch will lead water obtained from El Dorado Canyon and the Big Secret Ravine to a 100-acre-ft. storage reservoir at the mine. About 60 men are employed at the property.

Additional pumping equipment is being installed at the Empress mine, 5 miles west of Grass Valley, to take care of the heavy flow of water encountered on the 1,000-ft. level. Mining operations will be resumed as soon as the flooded workings have been unwatered.

Arizona

Two No. 1 electrolytic-centrifugal gold separators and a motor-generator set have been purchased by Sheep Tanks Consolidated Mines, of Vicksburg, Ariz., from the inventor, Russell Thayer, consulting mining engineer, of Philadelphia. The machines consist, essentially, of two cylinders, one within and insulated from the other, which revolve at a speed of 350 r.p.m. The motor-generator set is used to convert 60-cycle 220-volt a.c. current to d.c. current at 6 volts and 200 amperes. This direct current is delivered to the brushes of the separators, the inner cylinder being used as an anode and the outer as a cathode. About 15 lb. of mercury is poured into the space between the two cylinders. The ore, ground to 60 mesh and mixed with five to eight parts of water and enough acid to make the water an electrolyte, is forced through the machine between the two cylinders. As the machine revolves the mercury forms a coating on the inner surface of the outer cylinder, where the gold in the ore is drawn to it by virtue of centrifugal force and electrolysis.

Capacity of each machine is about two tons of ore per hour. The machine is said to recover not only coarse gold but also fine and rusty gold, gold in cyanide solution, and such metals as platinum and iridium. The invention is not a new one but has been on the market for some years. The separators are made by L. M. Bayard & Company, Inc., of Philadelphia. The electrical equipment is supplied by Munning & Munning, Inc., of Philadelphia, agents for Sceynenson & Company, of St. Louis, manufacturers of special equipment for the gold separators.

Several gold-mining companies have recently installed equipment in the districts around Prescott. National Gold, operating the Midnite Test property, has built a 200-ton capacity mill, equipped with a Blake jaw crusher, a Telsmith gyratory crusher, a No. 64½ Marcy ball mill which will run in closed circuit with a Dorr duplex Model C classifier, a 4x5-ft. Southwestern ball mill, four Deister Plat-O tables, a No. 12 Fahrenwald ten-cell flotation machine, and a Deister Plat-O pilot table. The company has also purchased five Denver Equipment reagent feeders, as well as complete assaying equipment which was furnished by the Braun Company and the Denver Fire Clay Company.

C. & B. Mining, which operates the Big Jim mine, at Oatman, is building a 100-ton capacity mill at the Oro Flamme mine, 10 miles south of Prescott. Machinery for this mill is being purchased from idle mills of the district, and the flowsheet has not been completely worked out as yet.

At the Davis Dunkirk property, a No. 18 Fahrenwald flotation machine has recently been added to the mill, which was built three years ago. Eight men are at work on development work in the mine. Production of ore for the mill is soon to be started, according to information received.

Operators and Developers, Inc., of Prescott, have installed a placer plant at the property known as the Copper Basin Placers. The claims are 300 acres in extent; 400,000 cu.yd. of gold-bearing gravel is available. The gravel is mined with a ⅜-yd. Model B Universal shovel and is transported to the plant in 2½-yd. Ford dump trucks, which deposit it in a hopper, whence it is fed to a 10-ft. trommel by a 20-in. by 5-ft. Telsmith plate feeder. Half of the trommel is blinded and the other half has ¾-in. openings. In the trommel the ore is thoroughly washed with a stream of water. Oversize from the trommel is carried by belt conveyor to a stacker. The undersize is screened on a 4x6-ft. Leahy No-Blind vibrating screen, which has ⅛-in. openings. Oversize from the screen passes through a 16-ft. sluice to the tailing stacker, the undersize passing over three Wilfley tables. Concentrates from the tables go to a Deister-Overstrom diagonal table, and are then further concentrated on a laboratory size Wilfley parting table to remove the black sands. The parting table concentrates are then treated in a Mine & Smelter Supply 3 ft. pan amalgamator. The plant uses 200 g.p.m. of reclaimed water and 100 g.p.m. of fresh water, which is pumped from the Loma Prieta shaft through a one-mile pipe line by means of an air lift, operated by a No. 181 M. & S. compressor and a 10x6x10-in. Scranton steam pump.

A 50-ton capacity flotation mill is being constructed at the property of Akron Gold Mining near Sells. Equipment will include a 150-hp. Diesel engine and a centrifugal amalgamator.

Nevada

Two new mills have been built and put into operation recently in Nevada, both of 50 tons' capacity. Consolidated Chollar, Gould & Savage, operating the Overman mine, on the Silver City branch of the Comstock lode below Gold Hill, is operating one, a flotation mill, equipped with six Kraut cells. The other is at Rosebud Canyon, northern Pershing County, where American Mining & Milling is milling ore by amalgamation and flotation from the Brown Palace mine.

Bernard Granville, New York mining engineer, who has taken over the Nevada Douglass mine, at Douglass, Mineral County, is rebuilding the Springer mill to 70 tons' capacity, employing the counter-current decantation cyanidation process.

At Virginia City, on the Comstock, Arizona-Comstock has installed a conditioner tank to increase recovery and bring the mill to capacity of 130 tons. A double-drum electric hoist has been installed at the inside transfer shaft on the Hale & Norcross adit level. Engineers who recently examined the property were unanimous in recommending that mill capacity be enlarged to 300 tons. The mill process is concentration by flotation, with 8 Denver sub-A Fahrenwald cells. Extraction of 90 per cent is expected to be increased by placing a conditioner tank at the head of the flotation machines.

Hydraulic placering of a large and rich deposit of auriferous gravel was begun Aug. 21 at the property of Ambassador Gold Mines, near Ludwig, on the west side of the Singatse range in Lyon County. Water is raised 540 ft. through a 10-in. pipe line 20,000 ft. long, from artesian wells at the head of Smith Valley. Gravel is ground-sluiced 600 yd. to the head boxes of a 1,500-ft. sluice. The sluice and tail race are set at 4 per cent grade, and the absence of boulders makes effective a smaller volume of water than usual, so that the finer particles of gold in black sand are caught in the riffles.

Montana

Lucky Tiger-Combination Gold Mining Company, of Kansas City, Mo., and El Tigre, Mexico, according to reports, has taken an interest in Gold Creek Mining and will start operations at the company's property along Gold Creek, Powell County. The company has several thousand acres of placer ground said to contain many million yards of gravel of good grade. A power line has been installed and all the parts of a Yuba dredge of 6,000-yd. daily capacity are on the ground.

As a result of the recent action at Washington whereby the world's market price may be received for the

metal, Montana gold camps are becoming very active, and leasers and prospectors have entered the hills by the hundreds. Nearly all of Montana's gold will probably go to Canada.

The Thompson interests of Portland, Ore., have taken over the Bannack mine, at the old camp of Bannack, Beaverhead County, and expect to start operations immediately. Bannack is equipped with electric power, modern mining machinery, and a fine-grinding cyanide plant of 150 tons' daily capacity. The valuable constituent of the ore is gold.

Roy Miller, Inc., is now treating the mill tailings at the Jib property at Basin, Jefferson County. The tailings are being picked up with a gasoline-driven shovel, and loaded onto trucks for delivery at the mill. They are then given a light pass through a ball mill, and treated in Ruth and Fahrenwald flotation cells. The company was planning to ship its concentrates to Trail or Anyox, British Columbia.

Virginia City Mining, operating at the head of Alder Gulch, Madison County, has encountered placer gold on bedrock, at a depth of 58 ft. The company is operating by means of a shaft, and recovers the gold in sluice boxes, with steel riffles. Much excitement prevails in the district as a result of this strike. The gold is sharp, and some of it is associated with quartz, indicating that its vein source is not far off.

Basin Goldfields, operating in the Pole Mountain district, near Basin, encountered an 8-in. vein of high-grade gold ore. This was opened in the No. 1 East tunnel, about 50 ft. underground, and is being sacked. The company was expecting to ship its crude ore to Canadian smelters or to erect a small amalgamation plant and ship amalgam across the border, but in view of the gold ruling this is now unnecessary.

The Beaverhead Mining Association, of Montana, and the Lemhi Mining Association, of Idaho, held their annual joint picnic at the historic old gold camp of Gibbonsville, Idaho, on Aug. 20, and about 500 members and guests attended. The speakers were Compton I. White, United States Representative of the First Congressional district of Idaho and the owner of the White Delf mine, Idaho State Mine Inspector Simons, and Carl J. Trauerman, Butte mining engineer and publicist. The latter predicted that the United States Government would soon pay about $30 per ounce for newly mined gold either by the creation of a subsidy or by devaluating the dollars to 16 grains of gold. He further stated that (1) while we are off the gold standard we still are on a gold basis; (2) a deplorable situation prevails in that nearly all of our gold production will go to foreign countries; (3) all kinds of chances are open for legalized bootlegging of the products across the borders of the country.

Utah

Steady improvement in the gold content of the ore being mined is reported by Caliente Cobalt Mining, which is shipping to a Salt Lake smelter.

At the Aurum Gold Mining property in western Tooele County, Gold Hill, Utah, from one to two carloads of ore is being shipped weekly.

Beginning of operations at the cyanide plant erected by the Snyder interests at Manning, near Mercur, for the treatment of 600,000 tons of tailing, is expected soon.

Michigan

Articles of incorporation have been issued to Michigan Gold Mines. The corporation has taken a lease on the old Michigan gold-mine property, about 8 miles northwest of Ishpeming, Mich., which was operated only a short time after its opening in 1887. Erection of a mill is under way, and a shafthouse is nearly completed. Expectations are that the mill will be ready for operation on or before Oct. 1. The management is counting on the efficiency of present-day methods of extracting gold to make the mine a success.

Manganese Association Files Petition

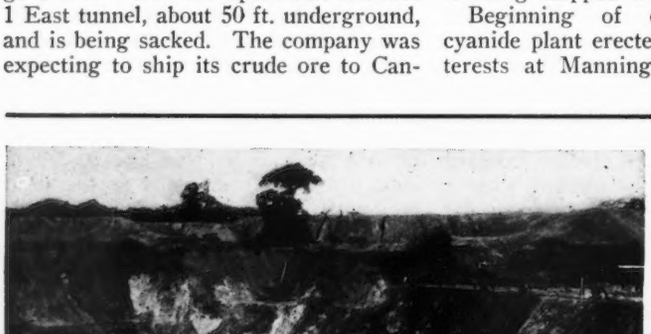
Limitation of foreign manganese ores, alloys, and products was asked by the American Manganese Producers Association in a petition to the President filed with General Hugh S. Johnson, Administrator, under the provisions of the NRA, for consideration immediately following the effective date of the code of the manganese industry.

Fifteen thousand men could be put to work in the manganese industry, declares the petition, if the full domestic market, normally amounting to $30,000,000 a year, is made available to domestic ores. The Association further claims that estimated reserves of low-grade manganese ores in the United States run from 200,000,000 to 600,000,000 tons. By means of newly developed processes, high-grade domestic ores recovered from the lower-grade deposits run 57 per cent metallic manganese, whereas similar foreign ores run only 48 per cent.

More extensive developments in the industry have been held up on account of the disinclination of domestic consumers to buy domestic ores even at prices less than the cost of foreign ores, during the years 1924 to 1928, and since 1929 on account of the importation and sale of foreign ores in the United States at sacrifice prices for the obvious purpose of establishing credits.

Employees in the manganese industry in India are paid wages averaging 1c. per hour, but by means of forced, convict, and conscripted labor paid with printing press rubles, according to the Association, the production and sale of Russian ore has forced the closing of many of the mines in India.

"When the NRA code of the industry goes into effect, workmen in the United States will be paid 30c., 40c., 50c., 60c., and 70c. per hour," says the petition. "It may readily be understood that American mines cannot long operate and pay their employees such wages if ore produced by foreign workmen at wages equivalent to 1c. or less per hour is allowed to monopolize the American market."



Portion of Kipushi mine of Union Minière, Belgian Congo

Ingenio Victoria of Patiño Mines & Enterprises, Bolivia

Mining More Active as NRA Rulings Become Effective

Reports From Various Districts Indicate a Marked Improvement In Both Sentiment and the Scale of Operations— Reopening of Old Properties Continues

ALL OF THE major non-ferrous metal mining industries filed Codes of Fair Practice with the NRA last month, details of several of the more important of which are presented on pages 359-63. Public hearing of the code for the lead industry has been tentatively scheduled for Sept. 23. The general effect of the filing of the codes and of the widespread adoption of the provisions of the President's Re-employment Agreement has been to stimulate activity in the various mining districts, as indicated in the paragraphs that follow. Wages have been increased in many instances, and in practically all camps additional workers have been re-employed. Organization of labor along national lines continued in several regions.

. . . CALIFORNIA

THE MILL of Consolidated Metal Mines at Arrowhead, San Bernardino County, is operating at the rate of 25 tons daily on ore from the Paymaster mine, situated about 25 miles distant from the camp.

GOLD LEDGE MINING, operating the Feliciana mine, on the Mother Lode in Mariposa County, has let a contract to drive a 1,000-ft. tunnel to tap known orebodies at depth. The new adit will reach the Feliciana orebody about 300 ft. below the deepest workings in the mine.

FLOTATION AND OTHER MILL EQUIPMENT is being added at the Queen Lil mills of the West Mines Corporation, at Nevada City, to handle the output of the Canada Hill, Ragon, and other mines controlled by the company. The Canada Hill shaft has been unwatered to a depth of more than 1,200 ft., and drifting from the 1,100-ft. level to reach the St. Louis vein is now in progress.

. . . UTAH

WAGE INCREASES at important producers, in three Utah camps; a resumption of activities at a half-dozen mines—among them Chief Consolidated, Combined Metals, Cardiff, and Honerine; and the beginning of operations of the new lead refinery at Midvale, Utah, of United States Smelting, Refining & Mining promptly according to schedule on Sept. 1, collectively give a decidedly more cheerful aspect to the outlook for the nonferrous mining industry in the Intermountain region.

EFFECTIVE SEPT. 1, the wages of 1,500 employees at the mine and the mills of Utah Copper Co. will be raised 50 to 85c. a day or approximately 20 per cent to the level prevailing between July, 1930, and October, 1931. During August, working days were increased from 20 to 27, which on the basis of rotation will increase the number of working days to the man from 10 to 14 a month.

EFFECTIVE AUG. 1, the wage scale at the Silver King Coalition mine, the Tintic Standard, and the Eureka Standard was increased 75c. a shift to conform with the provisions of the NRA. Announcement as to what action the other Utah producers will take has been withheld pending additional information from Washington on the code for silver-lead and copper minues. The wage increase, posted Aug. 16, affects 780 employees at the two Utah camps, with the scale at the Silver King Coalition now being $4 a shift for machine miners and $3.50 for muckers, and a scale of 25c. a day higher prevailing at the two Tintic mines. Employees will work on the basis of five 8-hr. shifts weekly.

AFTER INACTIVITY of several years, Cardiff Mining & Milling resumed shipments on Aug. 17 from its Big Cottonwood property, where a small crew is working on a promising showing of lead-silver ore between the 550 and 600 levels, about 3,000 feet from the portal of the main tunnel.

OPERATIONS were resumed on Aug. 15, on a "one-furnace" or 40 per cent of capacity basis at the Bauer mill of Combined Metals Reduction. At the same time, shipments were again started after a twenty-month layoff at two of the mines —the Honerine, at Bauer, Utah, and the No. 1 Combined Metals, at Pioche, Utah, —developed by the Snyder interests, of Utah, and the National Lead Company. About 160 men were re-employed, 80 at the Bauer mine and mill, and 80 at the Pioche property.

SO SATISFACTORILY has construction been carried forward at the new lead refinery of United Smelting, Refining & Mining, at Midvale, that pouring of the first bullion was made promptly on schedule early this month.

AT SACRAMENTO GOLD AND QUICKSILVER MINES, Mercur, Utah, a 35-ton mercury furnace, formerly operated at Beowawe, Nev., is being installed.

DEVELOPMENT is proceeding from the King David shaft of the Tintic Lead Company in the Horn Silver area near Frisco, Utah, near Milford. Plans for development of the Frisco Silver Lead ground near Frisco are announced by L. F. Block, manager.

SHAFT SINKING by the American Smelting & Refining Company on the Utah Metal and Tunnel property at Bingham has reached a depth of 200 ft.

OPERATIONS have been resumed at the Alta Champion property, where a crew is cleaning out the old Dwyer tunnel preparatory to prospecting the Alta ore zone. At the Pittsburg Silver, a small crew is prospecting ore showings in the lower tunnel level.

SEVEN CARLOADS of ore have been shipped by leasers working Chief Consolidated Mining ground at Eureka. They are in Plutus territory, between the 1,400 and the 1,600 levels of the No. 1 Chief Consolidated shaft.

NORTH OF EUREKA, in Iron Canyon, a showing of high-grade lead-silver ore has been opened up.

. . . NEVADA

NEVADA-MASSACHUSETTS, operating the only tungsten mines active in the United States, has put mine and concentrator on three shifts, and is milling 220 tons per day. Concentration is 100 tons into one. Scheelite concentrate, free from impurities, averages 76 per cent WO_4. Accumulated stock has been sold, and contracts have been made for the entire production for some time to come. The property is six miles from Mill City, Pershing County.

CONVINCED that heavier equipment and operations would be required to develop the deposit of high-grade copper ore acquired at Mountain City, Nev., by International Smelting, construction of a 30-mile power line from Jarbidge to Mountain City has been begun by the Anaconda Copper Mining Company subsidiary. The line is to be completed by Oct. 1. In the meantime, the company is installing a 600-cu.ft. Ingersoll-Rand compressor, an electric hoist, and a pump at the Elko County camp, situated 90 miles north of the nearest railroad point, at Elko. Development of a 75 gpm. water flow in sinking and crosscutting to explore the deposit of copper convinced the management of the need for a four-compartment shaft and electrically driven machinery. A crew of 27 men will be employed steadily at the mine this winter.

. . . MINNESOTA

IRON-ORE SHIPMENTS continue at a merry pace, and the last half of the season will be a busy one. The NRA Blue Eagle is being displayed in all mine office windows, showing that the operators are 100 per cent for the government steel code. Most of them are conforming to its requirements by working their properties

three 8-hr. shifts per day and five days a week, instead of two 10-hr. shifts six days per week, the old schedule.

BUTLER BROTHERS, independent iron-ore operators, have purchased from the Meriden Iron Company, Hibbing, Minn., the mines owned by Mace Iron Company and the Benore Company, at Nashwauk, which are close to their present operations. This company is unwatering the LaRue mine at Nashwauk, which was acquired in 1932, and will place it in operation for the remainder of the season. It is also shipping concentrate from its Margaret mine near Buhl.

ON THE CUYUNA RANGE Pickands-Mather completed unwatering their Sagamore mine at Riverton, and commenced shipments of its manganiferous ore. At least 100,000 tons will be shipped. This is the only active mine on that range, with the exception of the Croft mine, where the stockpile is being loaded.

THE NEW WASHING PLANT at the Canisteo mine, which is the largest on the range using Dorr washers, is running at capacity, and giving satisfactory results. This plant was erected in 1929 at a cost of approximately $400,000, but was not operated until last month. A production of at least 300,000 tons is expected before the season is over.

. . . MICHIGAN

THE OPINION PREVAILS that under any copper code that may be adopted, production in the Michigan district will not be increased above the present rate of output. On the other hand, with production down to a minimum consistent with an overhead cut to the lowest possible operating basis, no one can readily see how output could be further reduced. It could not be cut to a point where operations on the present basis of market price and costs would be unprofitable, for that would work to the detriment of labor. In so far as the future of the Michigan copper industry is concerned the view is held that the mines can compete with those of other districts in this country if a normal price for the metal is finally restored as the result of maintaining production at the lowest possible rate.

COPPER RANGE has announced a wage increase, the second within recent weeks, of 40c. a day, effective Sept. 1. Employees of Champion mine and mill and of the Michigan smelter will benefit. Salaried employees will receive individual consideration. The increase is conditioned on permission to maintain present production.

Intensive Exploitation of Australian Gold Areas Continues Unabated

WESTERN MINING CORPORATION, a Melbourne Company, has been granted large concessions, totaling 10,000 acres, in Western Australia, in the districts of Dunnsville, Norseman, Londonderry, Lake Barlee, Karnilbinia, Lake Way, Nannine, and Mount Jackson. These areas will be mapped by air photography and tested by electrical prospecting. The company has lodged £10,000 with the West Australian Government as evidence of its *bona fides,* and has guaranteed to spend £30,000 in development. An area 25 miles south east of Southern Cross will be examined immediately. Prospectors are allowed to operate on the concessions, but the corporation has the first option of purchase.

Great Boulder Pty., one of the oldest Kalgoorlie mines, has instructed Messrs. Chas. Ruwolt, of Melbourne, to proceed with the design, construction, and erection of a flotation, roasting, and cyanide plant, to treat 12,000 tons of ore monthly. This order marks an important step in the development of mining machinery manufacture in Australia. An extraction of 93 per cent is anticipated. Present ore reserves of Great Boulder Pty. total 538,000 tons, assaying 8 dwt. The company is carrying on a vigorous development campaign, and ore reserves will probably soon be considerably increased.

Several large alluvial areas have recently been acquired in Victoria. Browns Creek Amalgamated Hydraulic Sluicing has taken up 1,000 acres in the Scarsdale area; and Berry Kaboonga Deep Lead, 750 acres near Smeaton. Dredges are being installed at Freeburg, Yackandandah Creek, Campbells Creek, and Omeo.

The Mining Options and Development Syndicate has acquired an option over a gold dredging area near Mount Morgan, Queensland. The area has been scout bored, and 3,400,000 cu.yd. of high-grade wash have been proved. Further boring will be undertaken, and, if satisfactory, a company will be formed.

Electrolytic Zinc Company has announced that as yet no prospect exists of the completed lead-zinc flotation mill at Rosebery, Tasmania, being started up. A price of lead approaching £16 per ton is believe to be required to justify this step. The company is obtaining ample supplies of Broken Hill zinc concentrate at a very low figure, and has no special need for the Rosebery concentrate.

Experimental work is being carried out in the metallurgical department, University of Melbourne, on the treatment of oxidized copper ores of Cloncurry, North Queensland. F. M. Murdoch, the originator of a method tried several years ago on the Vulcan Mine, Queensland, is in charge of the work, under the general direction of Sir Herbert Gepp. Oxidized copper ore occurs at many scattered localities in the Cloncurry district, and at no one property is there a sufficient quantity to justify erecting a large leaching plant. Should a satisfactory method be developed, several small leaching plants with a capacity of 100 tons per day will be erected.

Western Gold Development Syndicate has acquired a lease of 48 acres at Wiluna, Western Australia. The shaft is down 100 ft, and the orebody is 17 ft. wide. The same syndicate is to form a company to work an alluvial area on the Lower Watut River, New Guinea.

Sons of Gwalia, Western Australia, has acquired leases totaling 2,500 acres, midway between Menzies and Leonora, and will test several promising surface indications. The company, which operates at Leonora, is treating higher-grade ore, and the developments on the bottom level, No. 26, are satisfactory.

Berry Mines Extended has acquired deep-alluvial leases of 9,000 acres near Ballarat, Victoria, and plans to spend £150,000 in development.

Gold Mines of Australia is gradually extending its operations. The company hold 85,700 fully paid shares in Mount Coolon Gold Mines, the promising new Queensland property, and an option over a further 100,000 shares. In Berry Leads, a new company recently formed to work a large area of deep alluvial with 6 ft. of wash at a depth of 150 ft., at Allendale, Victoria, Gold Mines of Australia has taken up 30,000 shares of the total 100,000 shares, of 10s. each. The company's latest development is to acquire an option over the Wentworth mine, at Ora Banda, 45 miles from Kalgoorlie. To a depth of 100 ft., 500 ft. of driving has shown high-grade ore. Sampling is now being carried out, and diamond drilling to a vertical depth of 400 ft. will follow. The West Australian Government is extending the Kalgoorlie water system to Ora Banda, and the development of promising properties is expected.

The Hercules gold mine, at Bendigo, is now crushing lower-grade ore, the latest fortnightly return being 466 oz. fine from 528 tons. More than 25 companies are now operating at Bendigo.

Gold Mines Development, which is developing the promising Yankee Mine at Trentham, Victoria, has treated 1,312 tons for a yield of 598 oz. fine. The main shaft is being sunk 100 ft. below the 230 ft. level. The capacity of the treatment plant is being increased by the addition of classifiers and tables.

Golden Gate has acquired an option over a gold lease at Nundle, New South Wales. Two large low-grade reefs have been proved for a distance of 2 miles. Costeaning and shaft sinking are to be undertaken.

Lake View & Star, Kalgoorlie, Western Australia, recently offered to purchase the Great Boulder mine, which has ore reserves totaling 211,000 tons. Great Boulder did not favor the amalgamation, and is expected to proceed with the erection of a new treatment plant, with a capacity of 12,000 tons monthly.

Granites Development has acquired an option over a lease of 24 acres at North Wiluna, Western Australia. The lease is situated in the Wiluna lode channel and is 3 miles north of the main shaft. To a depth of 210 ft. driving has proved 10,000 tons of high-grade ore. Mutooroo Copper Corporation has optioned a lease of eighteen acres in the Ora Banda district. The property is north of and adjoining the Wentworth mine, now being sampled by Gold Mines of Australia.

Wiluna Gold Mines, Western Australia, has completed the erection of a small plant to re-treat residues.

A surface galena lode has been found on the North Mount Farrell leases, Tasmania. The lode has been proved for 250 ft. with widths of high-grade ore varying from 6 in. to 20 in. The North Mount Farrel mine has been closed down for some months.

Four alluvial gold areas are being investigated in New Guinea. New Guinea Goldfields is boring two dredging areas in the Purari district; Australian Gold Development and Cracow Gold, in conjunction, are testing, for hydraulic sluicing, the Tyak leases in the Morobe district, and Bululo Gold Deposits are boring a sluicing area on the Upper Bululo River and Koranga Creek, in the Wau district.

The New Zealand Government is carrying out geophysical prospecting at Cromwell Flat, in the Kawarau Gorge district, with the object of tracing the path of a number of deep leads. Rich wash is being won from shallow wash in the area. The New South Wales Government has used geophysical methods successfully to define the path of the tin-bearing leads at Tingha.

Clunes Goldfields, an English company, formed in 1931 with a capital of £25,000 to carry on mining operations at Clunes, Victoria, plans to increase development activities so that sufficient ore can be proved to justify equipping the property.

The Queensland gold yield for the half-year ended June 30 was 40,422 oz., compared with 5,404 oz. for the corresponding period of last year. The increase is due to activities at Mount Morgan and Mount Coolon. At the former, the yields should soon show a substantial increase as mill extensions to 1,200 tons monthly are completed. At Mount Coolon 1,500 oz. is being obtained fortnightly from 2,600 tons. The new (No. 4) level on this property continues to be most unsatisfactory, and a total of 320 ft. has now been driven east and west in unpayable lode material.

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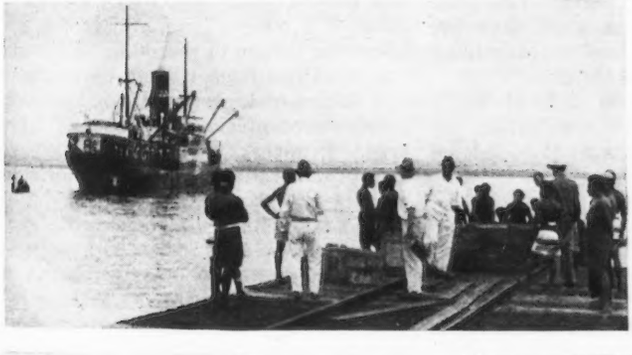
Reports From Mexico Include Many New Projects

Engineers of Sombrerete Mining are examining its mines in the Sombrerete region, Zacatecas State, with a view to conditioning them for an early resumption of work. General Eulalio Gutierrez, according to a recent announcement of the mines department of the Ministry of National Economy, plans soon to open up several mines in the Concepcion del Oro region of that state. . . . Potosi Mining and its metal-treatment subsidiary, Potosi Industrial, both operating in Chihuahua State, are reported to have increased their activities and restored salaries of their employees to pre-depression levels, because of improved conditions in world metal markets. The two companies are employing about 864 men. . . . Rio de Oro Gold Placer Mining has begun drilling 2,500 test holes on 900 parcels of land that it controls near Loma Bonita, Oaxaca State. . . . A rich gold claim, known as Dolores Segunda, about 5 miles from the great Dolores mine, in Chihuahua State, is being worked by Manuel de J. Encinas, of Madera, Chihuahua. A shaft 86 ft. deep has been sunk on the property, and stringers of high-grade gold-silver ore have been disclosed. Crosscutting will be started when the shaft is down 100 ft. . . . Backed by George Law, American aviator, who conducts an aerial transport service in Chihuahua State, and two Mexican business men of Chihuahua City, development work has started on the Fairchild mine, near Potrero, Ocampo district, Chihuahua. The enterprise intends to establish a 25-ton mill and to open up the 200-ft. level of the mine, which is said to be rich in gold and silver ores.

Fresnillo Mining has taken an option on gold-producing lands at Cinco Hermanos, El Cristo zone, Zacatecas State, and is arranging to operate these holdings, according to reports issued by the mines department of the Ministry of National Economy. The department announces that General Jose Cruz Rosas has formed a company with A. H. Schroeder and Franz Putsch to operate gold and silver properties known as "San Jose," "La Esperanza," and "El Porvenir," which he has under concession in the Tilzapotla zone, near Tehuiztla, Morelos State. This enterprise expects to ship ore to treatment plants in Aguascalientes City during September. . . . American Smelting & Refining has increased the working week in some departments of its metal-treatment plant at Avalos, Chihuahua State, from three to four or six days, according to reports issued by the Federal Labor Department, which expects that the entire plant will soon be on a six-day basis.

Mexico will soon have two more large metal-treatment plants. Cia. Minera Asarco, S. A., has been granted a concession by the Chihuahua State government to establish by Feb. 1 a 150-metric-ton daily capacity plant for treating by cyanidation methods gold and silver ores and concentrates at Santa Barbara, Chihuahua. . . . Cia. Minera El Fraile, S. A., operating gold and silver mines in the Mineral de la Rosa region, near Pachuca, Hidalgo State, has taken delivery of machinery for a 100-metric-ton daily capacity mill which it proposes to have in service soon. The company is altering its cyanide mill for the flotation system, to handle the company's ores and those which it buys from smaller mines in the



Wharf at Lae, New Guinea, port of entry for Bulolo Gold Dredging operations

New Red, White, and Blue mine at Bendigo, Victoria, Australia

district. If sufficient ores are obtainable, daily capacity of the mill will be increased to 500 metric tons . . . Fresnillo Mining has commenced operating the La Aurora and Los Tajos de la Aurora mines, about a mile from Zacatecas City, Zacatecas State, which it has under option for six months.

Cia. Minera de Tetela del Oro, S. A., backed by Mexican interests, has been organized in Puebla City, Puebla State, to operate gold and silver holdings it has in the Tetela de Campo region of Puebla. The enterprise proposes to install a 500-metric-ton daily capacity mill this month. . . . About 75 men are employed by the Rayon Mining Co. at its mines near Ocampo, Chihuahua State, with production averaging about 20 tons of high-grade gold-silver ore per day.

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Operations in British Columbia Continue to Expand

Much gold-mining activity prevails in the Nelson area of British Columbia. At the Reno property, in the Sheep Creek area, production is steadily increasing, and some exceptionally high-grade ore has recently been encountered in a newly explored ore shoot on the No. 5 level. On the adjacent Gold Belt mine, results of development at depth are proving most encouraging, and at the Kootenay Belle steps are being taken to enlarge the scope of operations, for which adequate financial provision has been obtained.

The most important recent event, however, has been the resumption of operations at the Monarch silver-lead-zinc mine, at Field, control of which is vested in the Mining Corporation of Canada and the International Mining Corporation, of New York. The mine which went into production in 1929 on the basis of 300 tons a day, was closed in August, 1930, on account of low metal prices. It is the first of the larger base-metal properties in Canada that have been inoperative during the depression to reopen. Three orebodies of considerable size have been developed in the property, the largest of which has been proved so far to be about 1,450 ft. long and 125 ft. wide. The management plans to increase the daily capacity of the mill at once from 300 to 500 tons.

The Relief-Arlington mines, near Salmo, have recently been optioned by a Vancouver syndicate, and work with a crew of 24 men has begun. In the Ymir area, the old Ymir mine has been bonded by the operators of the adjoining Goodenough mine. Another property in this camp, the Ymir-Wilcox, has also recently been acquired under lease and bond. The Two-Star mine, adjoining the Yankee Girl, which is the largest producer in this section, is to be reopened for exploration and development.

In the Lillooet section, active development is in progress on the property of National Gold Mines, on MacGillivray Creek, with a view to blocking out a reserve of ore for the supply of a 200-ton mill, the machinery for which has already been ordered.

Vancouver and New York interests have secured control of the property of B. C. Nickel Mines, at the head of Emary and Stulkawhits creeks, in the Yale mining division. Extensive development operations, which have already been started, are proposed, including the construction of a road to the property at an estimated cost of $25,000. The property comprises a group of 74 claims, on which large bodies of nickel-bearing pyrrhotite occur in a wide basic dike that intrudes the granite.

Copper production from the Britannia mine, at Howe Sound, is being increased, and last month 50 men were added to the payroll.

A strike, apparently of considerable importance, was made recently at the Cariboo Gold Quartz mine, in the Barkerville area, when, in a crosscut from a prospecting shaft that had been sunk to a depth of 110 ft. below the low level tunnel, at a point about 1,200 ft. from the portal, an orebody 50 ft. wide and of good milling grade was encountered.

Reno Gold Mines, operating in the Sheep Creek area, reports that major development on the 5th level has been driven a distance of 2,097 ft. The first oreshoot was encountered 1,100 ft. from the portal, and, to date, shoots on this level, measuring 619 ft. in length, have been cut with the face of the tunnel in ore. The work indicates that the oreshoots are gradually widening with depth.

Development operations at the Bralorne mine, in Bridge River district, continue to afford unusually gratifying results, and during the past month another vein, 5 ft. in width, with a high gold content, was encountered in the workings on the 8th level. The mine is estimated to possess more than five years' ore supply, based on a milling operation of 200 tons per day.

Machinery has been ordered for a small mill that will be installed on the property of the Columario Consolidated Gold Mines, near Usk.

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Three Lead-Zinc Properties In Serbia to Be Developed Soon

Arrangements have been made to proceed with the development of three lead-zinc properties in Serbia, Yugoslavia. Central Mining & Investment Corporation is purchasing 200,000 shares each of Zletovo Mines, Kapaonik Mines, and Novo Brdo Mines. A. J. Brett, M.I.M.M., recently visited the properties of these companies for Central Mining & Investment, accompanied by J. Whitehouse, M.I.M.M., joint managing director of Zletovo, Kapaonik and Novo Brdo, on basis of which visit these financial arrangements were made.

Each of the three companies has a large concession which was selected because of the great number of ancient, or long forgotten, indications of quite extensive mining activities. The numerous and widely scattered pits and caved workings seem to prove that the district is a large one and richly mineralized. In recent years the Selection Trust group in London tested the veins and limestones below several of the pitted areas, with the result that one big mine, the Stantrg of Trepca Mines, has been developed, which mine began paying dividends when lead and zinc were near the lowest prices of recent times.

Zletovo Mines has a 50-year concession over 537 square miles at Dobrevo, Yugoslavia, across which abandoned workings mark numerous veins of ore. Estimates made last November stated that 632,000 tons of ore averaging 15.4 per cent lead and 3.1 per cent zinc, with 4.6 ounces of silver per ton, was "partly developed and possible," as a result of the work done on No. 1 vein. This tonnage has been increased by work done since, the intermediate level having been driven a further distance of 37 meters in vein matter of good width and grade. An adit is being driven on No. 4 vein. For some distance this vein was narrow in the adit, but as work continued it became wider. Over the last 15 meters sampled its width is 1.50 meters, and near the face the width is now over 2 meters. A crosscut adit encountered No. 8 vein, in November, at 38 meters. This drive has passed through three short ancient stopes from 1.6 to 1.9 meters wide. In the face the vein is narrow, but the drive is about to pass beneath a stretch of extensive old workings.

Kopaonik Mines started exploratory work by opening up an ancient shaft, and in doing so disclosed a promising orebody. Later, in June, 1932, work was started on an adit, which was to be about 412 meters long, to cut the ore below the bottom of the shaft. This adit and workings from it have opened several bodies of high-grade lead-zinc ore, besides encountering old stopes of large area. It appears to be in an extensive area of mineralization, the total horizontal area of orebodies, old stopes and gossan so far being estimated by the general manager at 1,500 square meters. This ore occurs along and adjacent to an irregular body of andesite intruded into the limestone. The present plan is to explore the orebodies already opened on the adit level at greater depth, and also to drive under an extensive pitted area containing ancient workings.

Novo Brdo Mines holds the Janjevo Mining Concession of 395 square miles under a grant for a period of 50 years. Sufficient underground exploration, diamond drilling, geological and geophysical work was done about three years ago to prove the existence of comparatively large low-grade mineralized zones, but the work was discontinued.

Personal Notes·Comment·Criticism

John A. Reid is examining gold properties in Brazil for Toronto interests.

Wendell Hammon, geologist, has returned to San Francisco from a trip to Northern Mexico.

Edward Belden Greene has succeeded William G. Mather as president of the Cleveland-Cliffs Iron Company.

H. R. Plate is located temporarily at Grass Valley, Calif., where he is carrying on development of the Spring Hill mine.

C. N. Anderson, of Baxter Springs, Kans., has been in New York in connection with mining business on the Pacific Coast.

Livingston Wernecke, general superintendent, Treadwell-Yukon Company, Ltd., left San Francisco recently for Juneau, Alaska.

Dr. John E. Bacon, chief surgeon of the Miami-Inspiration Hospital, has been elected chairman of the Gila County Democratic central committee, Arizona.

H. E. McKinstry returned from South Africa in July and has gone to Australia, where he will be engaged in professional work for several months.

Dr. Norman D. Fitz Gerald, mining engineer and economist, is now with the Standard Statistics Company of New York City.

Ronald L. Pascoe, of Grass Valley, Calif., was recently awarded the first Holmes Safety Association medal for life saving, the medal being issued by the United States Bureau of Mines.

Prof. Robert S. Lewis, of the University of Utah, has returned to Salt Lake City after spending a month in the Timmins, Kirkland Lake, Noranda, and Sudbury mining districts of Ontario.

H. W. Hardinge, president of the Hardinge Company, has returned to New York from a visit to the Porcupine and Kirkland Lake districts of Ontario. He was accompanied by **W. H. Metz.**

George L. Draffan, formerly secretary of Ohio Brass Company, has been elected vice-president of the company and its subsidiaries. Mr. Draffan has been associated with the company for the past seventeen years.

Frank Henderson, electrical engineer and former employee of the Miami Copper Company, has gone to Juneau, Alaska, where he has accepted a position with the Alaska Juneau Mining Company.

Sydney H. Ball, of Rogers, Mayer & Ball, who returned from a professional trip to Canada on Aug. 5, is in the South making an examination. **Allen H. Rogers,** of the same firm, will be in Alaska for the next two months on professional business.

J. H. Saville, vice-president, The Pyrites Company, Inc., of Wilmington, Del., is spending several months at the Rio Tinto Mines, in Spain. He expects to visit in England and Germany before returning to the United States in the fall.

H. C. George, who took charge of the newly established school of petroleum engineering at the University of Oklahoma in 1924 and who has been director of the school since that time, has resigned, effective Aug. 1, to become head of the department of oil and gas at the University of Pittsburgh.

C. K. Leith, professor of geology, University of Wisconsin, has been appointed by President Roosevelt to be a member of the Science Advisory Board of the National Research Council. The new board will have authority to appoint committees to deal with specific problems of research.

R. E. Barthelemy, who recently resigned his position with Union Miniere du Haut-Katanga, has been appointed assistant manager of the S.E.E.M.I., the largest French tin-mining company operating in Indo-China. He will sail from the United States for the Far East next October.

C. G. McLachlan, superintendent of the Noranda concentrator, has been investigating for some months past the means of treating more economically the gold-copper ore of the company's mine. Recent results have been promising and are already seen in increased gold recoveries in the present concentrator.

Robert S. Hutton, professor of metallurgy at the University of Cambridge, was the guest of honor of the Electrochemical Society at its recent meeting in Chicago. He delivered the Faraday lecture on the occasion of the Faraday centennial celebration, on Sept. 8. Dr. Hutton was for eleven years director of the British Non-Ferrous Metals Research Association. In 1932 he was appointed to his present professorship, a chair established by the ancient Goldsmiths' Company of London.

Horace Moses, manager of the Gallup American Coal Company, Gallup, N. M., has been named general manager of the company, filling the office made vacant by the death of John M. Sully. **R. B. Tempest,** who was assistant general manager, has been named acting general manager of the Chino mines of the Nevada Consolidated Copper Company at Santa Rita and Hurley, N. M., and also elected vice-president of the Gallup American Coal Company, Gallup, New Mexico, filling the offices made vacant due to the death of John M. Sully.

H. A. Buehler, Missouri State Geologist, is supervising a study of clay deposits in the lowlands of Southeastern Missouri, including areas in Scott and Stoddard counties, to determine whether they contain fuller's earth in sufficient quantities for profitable commercial development. In some sections a rather thick bed of clay that has the characteristics of fuller's earth has been found along the Porter Creek formation, said to be the horizon at which this nonmetallic mineral has been found in Illinois. From a point 2 mi. south of Avert to Ardeola, in Stoddard County, a distance of about 7 mi., good exposure of the clay has been found. In Scott County the clay is exposed on the lower edge of the Benton Hills. The clay under investigation is yellowish-gray to bluish-gray in color and of uniform texture. The dominant mineral content is said to be montmorillonite, an essential constituent of all commercial fuller's earth. Some samples tested have assayed 95 per cent or more of montmorillonite. Small amounts of quartz, muscovite, glauconite, colloidal silica, tourmaline, feldspar, leucoxene, tourmaline, zircon, epidote and rutile have also been found in the clay.

The Function of Gold

The Editor:

Mr. Percy Bursie in his letter in the July number of the *Engineering and Mining Journal,* proposing a new international standard of value, starts with a premise, which has been that of several recent theories on the world crisis—namely, that the supply of gold is to blame for the world's ills under the gold standard.

He says, "The price created by fluctuations in supply and demand for gold follows . . . the same economic laws as prices in general, though under the Gold Standard —as it has been applied—the effect is expressed reversely; that is by fluctuations in the prices of commodities. The present state of world trade proves that the extensive demand for gold has raised the price of that metal to such a height that all confidence in the same as serving the purpose of being a reliable international standard of value has been withdrawn."

The fact is, however, that whereas gold would follow the same economic laws of supply and demand as other commodities if the conditions of its production and consumption were similar, these are not similar. Other important commodities are produced for consumption or for use from which but a small part is recovered and returned to the market. A carry-over of stocks amounting to as much as a year's supply of a product indicates an unhealthy condition for that industry.

With gold the case is quite different. The reserves in the central banks exceed 500,000,000 oz.; the annual production is in the nature of 22,000,000 oz. (23,900,000

in 1932) of which about 7,000,000 oz. usually go for non-monetary purposes (industry and hoarding in the East). The gold available for use is made up of the gold reserves plus additions from new production, and since the latter amounts only to 3 per cent or 4 per cent of the whole, variations in production in any year or two have no appreciable effect on the total stock of gold available for credit.

To speak of the "extensive demand for gold" which "has raised the price of that metal," as does Mr. Bursie, when what we have had is a tremendous decline in industry and trade, is to disregard the essential facts so far as the world as a whole is concerned.

What is of essential importance in the long run is that the gradual increase in gold reserves should equal the increase in production and trade. As to this point, the Gold Delegation of the Financial Committee of the League of Nations (report of June, 1932) reports as follows:

"During the six years from the end of 1925 to the end of 1931, the world's central gold reserves increased from about $9,150 million to about $11,350 million, or at an average rate of 3⅜ per cent per annum. Since this rate is not lower than the generally accepted normal rate of growth of production and trade in the gold using countries as a whole, and since, in addition, certain economies were made in the use of gold, at any rate in the earlier part of the period considered, there seems to be little ground for believing that the total supplies of gold available for monetary use have not been sufficient to meet the reasonable demands."

The report says further that it is their opinion that "the world's stocks of monetary gold, apart from any consideration as to its distribution among different countries, has at all times in recent years been adequate to support the credit structure legitimately required by world trade, and that the rapid decline in prices, which began in 1929, cannot be attributed to any deficiency in the gold supply considered in this sense."

If a further demonstration is needed of the fact that the gold supply *per se* does not affect prices, the record of 1932 serves as a good example. Not only was the production of 23,900,000 oz. a record for all time, but in addition there were shipped from India to London approximately 13,000,000 oz., which came out from private hoards in India because of the increased purchasing power of gold with a depreciated currency. As a result the principal central banks of the world increased their gold reserves by $788 millions, or about 9½ per cent. If the supply of new gold (that is to say new to the world banking system) affected prices directly, gold should have gone down in value, and had the effect of raising prices of commodities in terms of gold. Actually the very opposite effect took place.

An indication is given of how the gold standard failed (and this is not precluded by what is said in the report of the Gold Delegation of the League of Nations) in a memorandum on the World's Gold Reserves by the late Joseph Kitchin (published with the *Economist*, London, Jan. 21, 1933). He shows that from December, 1928, to December, 1931, the central banks of the five principal gold-holding countries (U. S. A., France, Switzerland, Belgium, and Holland) increased their reserves by $2,510 millions or 46½ per cent, whereas during the same period, the reserves of the whole of the rest of the world (including the British Empire) were reduced by $1,470 millions, or 33.6 per cent. His conclusion he puts as follows:

"To support a given level of prices in a gold-standard world, gold reserves should increase at a rate approaching that of the world's economic development. If gold flows to some countries to such an extent as to cause a shortage in other countries, this shortage will exercise a determining influence on the world price level, irrespective of the gains of the first group of countries."

To me, this, more than any other factor, seems to have been the primary cause of the decline in world prices, which in turn had its effect on American internal prices and thereby brought on the crash in the stock markets. Furthermore, that the later accentuation of the depression in a downward spiral of dropping prices and decreasing industry was the natural result of the fact that the basic causes of the disease were not alleviated but rather accentuated. If this conclusion is correct, the best difficulty consisted not in gold which was used merely as a counter or yardstick for credit, but in the maldistribution of credit itself. Under these conditions it is difficult to see how the substitution of a theoretical basis, be it founded on "an abstract factor" such as Mr. Bursie proposes, or on price index numbers as proposed by others, would have solved the difficulty, or would solve it now.

There is, however, this to be noted: if the gold standard fails, because of causes which have to do with the credit structure itself, at least the gold remains with its value determined by the human effort required in its production; but if the credit basis were theoretical, how are we to know that confidence in it would not be swept away completely, leaving us with no measure whatever for international commitments or trade?

Greenwich, Conn. HUNTINGTON ADAMS.

Gold Hoarders Should 'Ware This Doodle Bug

The Editor:

I gave the narrator of the accompanying story about a dozen old blueprint machine electrodes the other day, and he told me about his new ore and treasure finder. He has a wonderful machine, and I told him that he should describe it, especially the one that can detect paper money—that is, if the money is gold certificates. He said, "Why, Bill, they wouldn't print it. These magazines don't print nothing but fiction, and this here is a true story." I asked him if he had any objection to my writing and sending the story away, and he said "No; go ahead. If you find anyone who'll pay for it we can buy some beer with the money and help out the Government. Why, looking at it that way, it's a sort of patriotic duty for somebody to buy it."

This section of the country is a fertile field for treasure detectors, as rumors have given us innumerable Spanish and Mexican treasures. I have heard some wonderful stories about the merits of the various machines, but this is the best of all. I forgot to ask Shorty whether his layout would find gold certificates now that the country is off the gold standard. If you can use the story both Shorty and myself will be pleased. WM. P. CRAWFORD.

Bisbee, Ariz.

The story follows:

"Shorty" Hamilton was in the office the other day asking for an old carbon electrode, and, on being questioned, said that he was helping build a radio ore finder. Further questioning brought out this tale:

This is the second machine we've built. The first one was a dandy. It had about $140 worth of platinum for points, but the lightning struck it and burned everything up. We're going to use the old arc-light carbons in the new machine. It's not as good, but it's lightning proof.

The first machine was awful sensitive, especially to gold. We tried it out on gold watches and gold teeth and stuff like that, and it worked fine. Jim wanted to go up in the Black Canyon country, north of Phoenix; said there was a lot of placer ground and gold quartz veins and we'd find a mine. We packed the machine in my car, and it didn't do much until we reached Bumblebee, and then it went crazy. The needle pointed northwest and the bell was ringing, and Jim says, "There's a mine round here some place, pardner." We followed the line as far as we could drive and then packed the machine—it wasn't very heavy—for three of four miles. The further we walked the better she was acting, and finally we come to an old prospector's cabin. He was home—an old fellow, all bearded up like a billy goat—and asked us to come in. We took the machine in the cabin and Jim took some readings. There was gold ahead of us all right and there was something close to the cabin that kept bothering with the quartz vein readings Jim was getting. The old fellow told us about his claims and it checked just what the machine showed; so we asked him if he wanted to sell. He was agreeable—wanted $5,000 for the four claims. We went down to Nogales, raised the cash and took it back. He signed the deeds, and after we counted out the money and everything was settled, he said, "Gents, the place is yours." He went over to his bunk, fished around under it with his cane, and dragged out an old suitcase. He opened it to put his money away, and we saw a big roll of gold certificates. Jim says, "Shorty, there's what was a-boogering up our machine. It was them damn yellowback bills."

OBITUARY

Royale Hillman Stevens, general manager of the Rhodesia-Broken Hill mine, on July 18 at Broken Hill, Southern Rhodesia.

F. F. Woods, of 207 Fulton Building, Pittsburgh, Pa., factory representative of Roots - Connersville - Wilbraham, Connersville, Ind., on Aug. 3.

Dr. L. L. Hubbard, at Houghton, Mich., on Aug. 3. Dr. Hubbard was former state geologist and regent of the University of Michigan for 22 years until January this year, He was 84 years old.

Roberta A. M. Callow, wife of John Michael Callow, metallurgist; at Redhill, Surrey, England, on Aug. 13. Mrs. Callow, a resident for many years of Salt Lake City and New York, was prominently associated with the Womens' Auxiliary of the A.I.M.E. and the Engineering Women's Club of New York City.

BOOK REVIEWS

Structure of the Earth

IGNEOUS ROCKS AND THE DEPTHS OF THE EARTH. *By R. A. Daly. McGraw-Hill Book Company, New York. Pp. 572; figs. 190; tables 63; $5.*

This book is quite different from Professor Daly's 1914 work, which has had such a profound effect in the last two decades. Every metal miner, geologist, and chemist will find in it a stimulus to more thoughtful and intelligent work, as well as a reservoir of facts on the physical properties of igneous rocks.

The reviewer has said that a hunch is an induction from a single instance, a hypothesis a verified hunch, a theory a verified hypothesis, and a natural law a verified theory. The work would not be Daly's did it not have a brilliant assemblage of hunch, of hypotheses and alternative explanatory theories, as well as established laws. One of the strong points is deliberate and critical assemblage from the wide reading and acquaintance of the author of multiple working hypotheses, with due bibliographic references. The collection of various modes of occurrence of the igneous rocks and the names applied to them is a valuable feature, and any mine geologist should look it over and see if and why certain terms do not apply to the deposit he is developing.

Fundamentally, the book differs from its predecessor in that it accepts and uses as a thread for its facts the hypothesis of a glassy, basaltic "simatic" substratum, underlying, injected into, and redissolving a relatively strong, layered crystalline crust, migrating over this lower layer that has no strength, though of high viscosity.

The stress is mainly upon the chemical characteristics of the igneous rocks rather than on their texture or grain. To the distinction made between the plutonic rocks and the effusive rocks of the same species, the reviewer would add that the latter have more ferric iron relative to ferrous, and more water. Their connection with the character of the injection as "legato" or "staccato" (not necessarily the same as the reviewer's "invasive" and "suctive"), is discussed, but other factors are weighed, such as the volatile agents engaged in igneous action, pure melting, magmatic assimilation, or syntexis, besides magmatic differentiation.

In his 1914 book, the theory of igneous injections was adjusted to the theory of a contracting earth. This is not wholly discarded, but is relegated to a place of less importance in view of the lower geothermal gradient and contribution of heat by radioactivity indicated, and the horizontal crustal movements which are a feature of modern interpretations of mountain structure. Daly summarizes the various arguments for, and explanations of, continental drift, with ideas and comments of his own; treats the fact, whatever the explanation, as fairly well established, and considers the application to the abyssal injections whence all others spring.

The last part of the book is a detailed discussion of the various igneous rocks by clans, especially with reference to their chemical character and origin, as affected by mineralizers' loss or gain, differentiation, fusion or solution, and is valuable for reference on particular rocks and districts.

ALFRED C. LANE.

NIRA

THE NATIONAL INDUSTRIAL RECOVERY ACT: An Analysis. *By Benjamin S. Kirsh in collaboration with Harold R. Shapiro. Central Book Company, New York. Pp. 156, 5x7. $2.50.*

This volume is an aid and guide to those who are concerned with the operations of recently enacted legislation. For the benefit of trade association executives it contrasts the possible activities of trade associations under the anti-trust system and the terms of the new act. It emphasizes the social aspect of the provisions applicable to labor, and points out that the liberalization of the Federal anti-trust laws is incidental to compliance with the Government's interest in the public welfare. The volume is annotated with numerous references to legal and social literature.

Silver Facts

SILVER MARKET DICTIONARY. *By Herbert M. Bratter. Published by the Commodity Exchange, Inc., 81 Broad St., New York. Pp. 202. $2.50.*

The volume was prepared to answer the questions that arise in connection with silver both as a commodity and a currency. In addition to a statistical summary of production and price, the book contains details of silver market practice in all of the leading trading centers in the metal.

A Revision

LEAD: ITS OCCURRENCES, USES, MINING *and* METALLURGY. *Second Edition. Imperial Institute, South Kensington, London, S.W. 7, England. Price 4s. net. Pp. 253.*

This revised edition is part of the Imperial Institute's series on the mineral resources of the British Empire and foreign countries. Over 70 per cent of the book consists of a summary of information concerning the occurrence, geology and mining of lead ores. No country of occurrence is neglected. In the section on metallurgy, the new continuous refining process at Port Pirie, Australia, is described. Much useful statistical and bibliographical information is included.

How Heavy?

WEIGHTS OF MATERIALS. *By J. M. Callow and staff. London: General Engineering Company, Adelaide House, E.C.4; price 2s.; New York: General Engineering Company, 50 Broad St.; price 50c.*

This booklet contains a compilation of data from many sources on the specific gravity and weight per cubic foot of minerals, rocks, mining products, solids, liquids, gases, woods, and other materials, together with tables on the percentage of voids in various crushed products. It should prove a valuable and useful addition to the works of reference in an engineer's library.

Publications Received

Mineral Resources of Puerto Rico. Report of Special Committee, 1933. San Juan, P. R. Pp. 10.

Map of Part of Gold Coast Colony. Second Edition. C. D. Syndicate, Ltd., 107 Moorgate Station Chamber, Moorfields, E. C. 2, London. Price 2s. 6d.

Chemistry of Cyanidation, Part I. By George Barsky, S. J. Swainson and Norman Hedley. Technical Paper No. 21, American Cyanamid Co., New York. Pp. 8.

Mineral Industries of Pennsylvania. Trends of the Mineral Producing and Processing Industries. By R. E. Murphy. Published by Greater Pennsylvania Council, Pennsylvania State College, Penn. Pp. 185. Price $1.

Provisional Geological Map of Tanganyika With Explanatory Notes. By E. O. Teale. Bulletin No. 6 of the Geological Survey Department. Dar es Salaam, Tanganyika Territory. Pp. 42, accompanied by map and chronological table of geological formations. Price 4s.

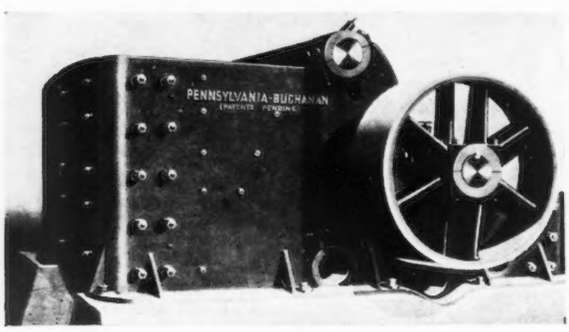
Minerals Yearbook 1932-1933 (designed to supply timely statistical information and taking the place of various former publications, including Mineral Resources of the United States, which will be discontinued. No Mineral Resources volume for 1932 will be issued). U. S. Bureau of Mines. For sale by Superintendent of Public Documents, Washington, D. C. Price $1.25.

INDUSTRIAL PROGRESS

Novel Ideas in Jaw-Crusher Design

Primary Breaker Embodies Interesting Features

Squarely meeting the exacting service requisites for primary crushing equipment, the Pennsylvania Crusher Company has developed the Pennsylvania-Buchanan primary jaw crusher only after extensive engineering research. In designing this unit, says an engineer of the company, the uppermost consideration has been to bring out a machine that would be an unquestionable improvement on former crushers of this type. Every functioning part was given careful study, not only from the standpoint of strength and durability, but also facility for replacing wearing parts. Substitution of throughbolts for studs, and the use of body-bound bolts instead of loose-fit bolts for permanent alignment of some parts, is an example of the attention paid to design detail.



An exterior view of newly designed crusher

The frame consists of four parts: two side frames and front and rear heads, of cast open-hearth steel, annealed. Very deep sections are employed for the heads, and both these and the side frames are of the box form of construction, with horizontal and vertical ribs, sufficient in number to give proper distribution of load to the outer members. In the design of these parts, all sections are as uniform as possible, and there are no heavy lumps of metal at any place to cause contraction and cooling cracks.

The method of joining and holding the side frames to the heads has been accomplished by heavy machined lugs at each end of the frame, fitting snugly to machined mortises in the front and rear heads. This, together with a double row of heavy through tiebolts at both ends, gives a straight-line tension distribution to the frames, and the heads are held from tipping by machined lugs which fit tightly to the machined surface of the side frame ends. The side frames are bored for the reception of the swing jaw shaft and removable main bearing shells, which are water-jacketed, to insure cool running under the most severe service conditions. The front head is planed for the reception of the stationary jaw plates, and the rear head is planed for contact with the tail piece.

In this unit the swing jaw is an annealed open-hearth steel casting, with a very deep section of the box form of construction. Horizontal and vertical ribs distribute the crushing load to the tension member of the casting, and heavy lumps have been eliminated to insure sound metal throughout. It is planed for the reception of the jaw plates, and bored and bushed with removable bushings for the swing jaw shaft.

For a long time the pitman has been a problem in large jaw crushers. It must be strong and rigid, but undue weight is prohibitive, as the eccentric movement of this member causes excessive vibration, and if it is too heavy the entire crusher is thrown out of balance. This pitman is constructed of special steel shapes, cut and machined to exact measurements, and these parts are then welded so as to give the greatest possible strength and rigidity with the minimum of weight. The pitman is fitted with removable bearing shells and the upper shell is water jacketed.

The toggle system is of new design, only three members being required to act as bearings for both front and rear toggles. This has been accomplished by the unique design of the pitman, as only one member is necessary as a central bearing for both toggles. It is placed directly in line with the eccentric shaft, giving a straight pull on the pitman no matter in what position it may be, and is therefore self-aligning.

The toggles are of unusual design with over three times the usual bearing area, and consequently with bearing pressures proportionately light. A safety feature is also provided in the rear toggle. The toggles are fitted with a liberal lubrication system, which is serviced at readily accessible points. The complete lubrication has been given careful study, with the result that these crushers will require only a fraction of the lubricant necessary for earlier designs.

Both swing jaw and eccentric shafts are of forged steel, and of very large diameters to insure rigidity and give low bearing pressures as well.

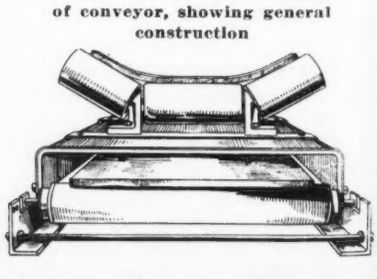
Flywheels of ample but not excessive weight are furnished. The standard machine is arranged for single flat or multiple V-belt drive, although any of the modern systems of driving can be readily used.

Refinements in Building Belt Conveyors

Supporting Structure Improved—Other Changes

The high degree of efficiency attained in modern belt conveyors, particularly in regard to the troughing rollers and idlers, has deflected attention to opportunities for refinements in general design of the complete equipment. Of particular interest in this connection are developments by Mavor & Coulson, Ltd., of Glasgow, Scotland, of a supporting structure consisting of inverted steel troughing, in 12-ft. lengths, which protects the returning belt, yet permits inspection, by easy removal of cover pieces, at every return idler.

Fig. 1—Vertical cross-section of conveyor, showing general construction



The driving drum is rubber covered. In the motor-driven unit the motor and

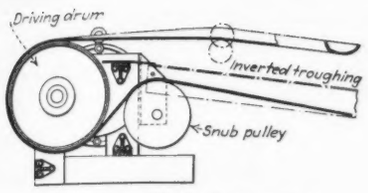


Fig. 2—Longitudinal cross-sectional elevation of drive end of conveyor

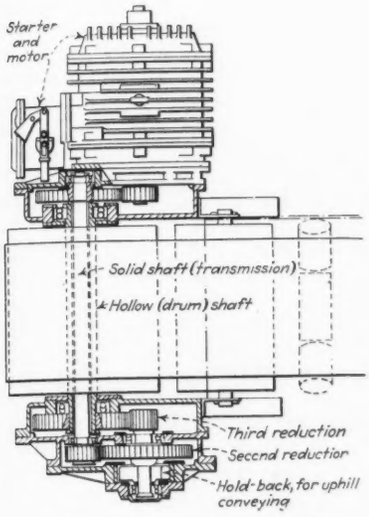
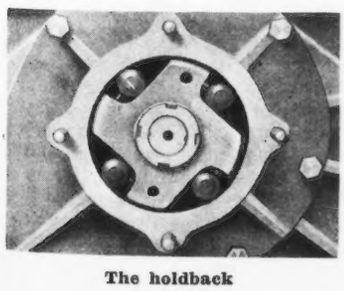


Fig. 3—Plan of drive end, showing starter, motor, and transmission equipment

gears are in dustproof and oil-tight cases; and a holdback, for uphill conveying, is provided. Use of ball bearings for every turning part insures minimum power consumption, and facilities are provided to keep the belt central to prevent undue wear.

The line drawings shown herewith illustrate these features: Fig. 1 is a cross-sectional elevation of belt, troughing idlers, reversed-trough structure, and return-belt idler. Fig. 2 is a longitudinal cross-sectional elevation of the driving end of a conveying installation, showing position of drum, snub pulley, and inverted trough structure. Fig. 3 is a plan, showing starter and motor, transmission shaft, reduction gears, and position of what is known as the holdback, illustrated in detail in a halftone cut. The center pin in this, fixed to the end of the shaft, is free to turn clockwise. It is held from turning in the opposite direction by four rollers in wedge-shaped recesses,



The holdback

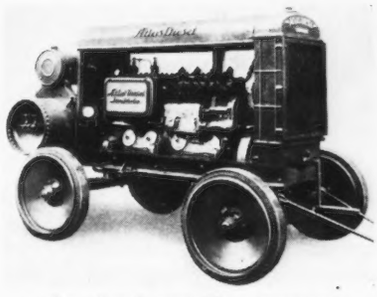
the rollers being kept from chattering by spring-loaded pins.

The conveyor equipment described is particularly well adapted for ore transfer underground, because of the protection of moving parts and the unit character of the elements comprising the structure, which in itself is capable of withstanding all operating strains, and designed for easy dismantling and re-erection.

Starting Difficulties Eliminated in New Diesel Compressor

A new type of diesel-engine-driven portable air compressor, No. C4DKV, manufactured by Atlas Diesel Company, Ltd., has been in operation in Scandinavia under severe climatic conditions during the past eighteen months, with satisfactory results. Starting difficulties, hitherto the principal objections to such machines, have been eliminated, the unit starting promptly in temperatures as low as minus 30 deg.

The diesel engine is of the two-stroke, solid-injection type, with simple mechanism, valves, and valve gear. Efficient



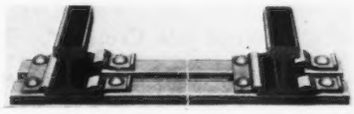
Atlas diesel portable compressor

scavenging arrangements insure perfect combustion at all loads and minimum fuel consumption. The compressor is double-acting, the lower half serving as a scavenging pump for the diesel engine. The unit is fitted with extra-large radiator, suction air-intake filter with silencer, hand unloaders, and a Bosch fuel injection pump with slow-speed governor. This slow-speed gear differs from the general design of such devices in that it allows the engine to reach maximum speed before the compressor takes up the load, thereby avoiding the strains imposed by designs that necessitate the engine accelerating to speed under load.

Renewable liners are provided for compressor and engine cylinders. Reciprocating parts are balanced, and the unit runs without vibration. Specifications are: Working pressure, 100 lb.; speed, 1,000 r.p.m.; compressor, twin cylinder, 190-mm. bore and 90-mm. stroke; piston displacement, 180 cu.ft. per minute; indicated capacity, 130 cu.ft. free air per minute; engine, 4-cylinder, 90-mm. bore and 130-mm. stroke; power developed, 30 hp.; fuel consumption, continuous full load, 13 lb. per hour; fuel consumption, average, 10 lb. per hour.

Steel Mine Tie

A new steel mine tie has been brought out by Bethlehem Steel Company, designated as their No. 2 steel mine tie. By redesigning the section, the tie has been given 93.5 per cent greater strength than the tie which it replaces, while the weight of the section, 2.5 lb. per ft. represents an increase of only 3 per cent.



Improved steel tie for mine work

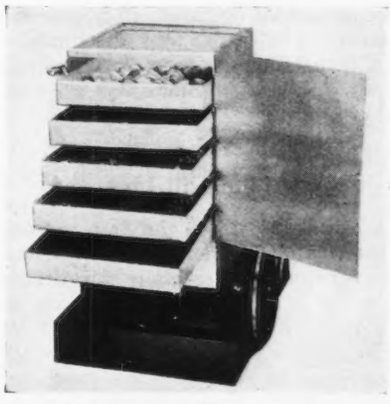
This tie is equipped with two broad, stationary rail clips and four movable clips of new design. These clips have greater bearing area on the rail base and are, therefore, not easily loosened by vibrations of track-type loading machines.

A New Shovel

A 2-yd. shovel having boom and dipper sticks of all-welded construction has been introduced by the Northwest Engineering Company, Chicago, Ill., as its Model 80. It is powered with a special 4-cylinder, 8x9-in. gasoline engine, constituting a heavy-duty, slow-speed power unit. Crawler design is said to permit unusual mobility. The engine drive gears are mounted on anti-friction bearings and run in oil. All high-speed shafts are mounted on self-aligning ball bearings.

Mechanical Testing Screen

Repairs and replacements are said to be reduced to a minimum in a new mechanical testing screen developed by the Hendrix Manufacturing Co., Carbondale, Pa. It is made in two sizes. The smaller, for testing aggregates, such as stone, gravel and slag, has sieves 18 in. square and will take a 50-lb. sample and screen it thoroughly in 1½ to 2 minutes. The larger screen, for coal, has 24-in. square sieves. One of these screens is shown in a cut. Four bolts hold the screen box down on rubber shock absorbers on the

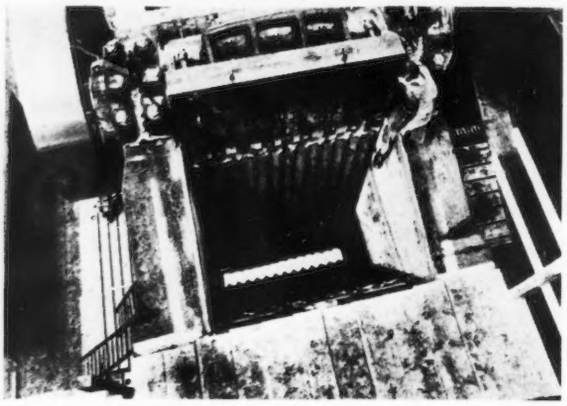


Mechanically shaken testing screen

foundation frame, utilizing the compressive action of springs attached to the lower end of the bolts. A camshaft is mounted beneath the box. As the shaft rotates, the cams act against followers fixed in the bottom of the box, thereby raising each side horizontally and dropping the box $\frac{1}{4}$ to $\frac{1}{8}$ in. from the high point of the cam to the shock absorbers. At the same time there is a slight horizontal motion.

Heaviest Jaw Crusher

In the shops of Krupp-Grusonwerk, Magdeburg, Germany, a jaw crusher of unusual dimensions has recently been completed. It has a breaker mouth 1.6 m. (63 in.) wide and 2.2 m. (96.6 in.) long and can take blocks of rock or ore up to these dimensions and weighing as much as 10 tons. It handles the contents of a 20-ton car of rock in $1\frac{1}{2}$ to 2 min. In construction, it is unusually strong. The swinging jaw weighs about 40,000 kg. Flywheels are 3.2 m. in diameter and weigh 13,000 kg. each. Total weight of the crusher is 235,000 kg. (518,081 lb.). Height to top edge of frame is 5.2 m., total length 6.5 m., and exterior width, including flywheels, 6 m.



Looking down into the hopper of heaviest jaw breaker

New Size Underground Loader

Word has been received that Eastern Iron & Metal Co., Salt Lake City, Utah, has developed its Eimco-Finlay loader, compressed-air-operated, in a new size intended to load 4 to 5 tons per minute. A trial installation has been working in the mines of the United States Gypsum Company.

Blast Hole Drill Improved

What is said to be the first and only all-steel full-crawler-mounted percussion drill made especially for drilling holes of 6 in. diameter has been developed by Keystone Driller Co., Beaver Falls, Pa., which claims that it is also the first machine to be completely chain-driven, a unique feature being a central power transmission system employing roller chains, which eliminates slippage and reduces bearing loads greatly as compared with a belt drive. The machine is equipped with dual spring shock absorbers for wire drilling and is compact and strongly built. Over half of its weight is concentrated in the crawler assembly, giving a low center of gravity and stability on steep hillsides. The machine has a capacity of 900 ft. of hole and is especially suitable for blast hole work in limestone and sandstone where the 6-in. hole is usually the largest which can be used economically. Although maximum economy of operation is attained when drilling 6-in. holes, the machine may be used for drilling larger holes. High-speed parts run on large ball and roller bearings. Thus it is that the machine weighs only 14,000 lb., although comparing favorably with other machines weighing twice as much. One of these drills has recently been shipped to the Bulolo Gold Dredging Company, in New Guinea.

Clutch-Type Convertible Excavators

In a new series of clutch-type convertible excavators, the Marion Steam Shovel Co., Marion, Ohio, has sought to secure the maximum in mobility, versatility, long life and strength. Operating speeds and digging power have been materially increased. The new units are of the straight friction fully-convertible type consisting of a primary power unit (either gas, diesel or single electric motor), connected through a master clutch and speed reducing mechanism directly to the main machinery. The various functions are independently controlled through friction clutches. Conversion from one type to another, it is said, can be effected quickly on the job.

Safe Package for Blasting Cap

Greater convenience in handling and use, as well as added safety, is said to be afforded by a new packing for individual electric blasting caps developed by Atlas Powder Co., Wilmington, Del. The cap itself is of the insulated match-head type developed by the company. In the package the wires are folded accordion-wise, the folds being laid around the cap to protect and cushion it.

Industrial Notes

George V. Christie has resigned as general sales manager of the Gifford-Wood Co., Hudson, N. Y. He has likewise resigned as vice president and general manager of the company subsidiary, Van Blerck Marine Motors, Inc.

Canadian Vickers Limited have acquired all manufacturing and sales rights controlled by William Hamilton Limited, of Peterborough, Ont. The lines of the latter company will be carried on by the William Hamilton division of Canadian Vickers Limited.

Combustion Engineering Company, Inc., a newly organized company, has taken over the properties of International Combustion Engineering Corporation and affiliated companies recently sold by court order.

W. G. Crossle, senior partner in charge of engineering of Crossle & Duff, Pty. Ltd., Melbourne, Australia, has left for England after a several weeks' visit to the United States. Crossle & Duff, Pty., Ltd., are representatives and manufacturing licensees of the Dorr Company, Inc., and Oliver United Filters, Inc., in Australia and New Zealand and their mandated territories.

Bulletins

Centrifugal Pumps. Mather & Platt, Manchester, England. Catalog P 455a, describing Solovane centrifugal pumps, for heads up to 125 ft. Pp. 4.

Electrical Equipment. Mather & Platt, Manchester, England. Catalog E 701. Direct-current motors and generators. Pp. 8. Also Catalog E 702. "S" type alternators, for single, two- and three-phase systems.

Pumps. Morris Machine Works, Baldwinsville, N. Y. Bulletin 149. Side suction volute pumps in sizes 1 to 20 in. for capacities up to 14,000 g.p.m. at heads up to 120 ft. Pp. 16.

Compressed Air. Ingersoll-Rand Co., New York. Catalog. Portable compressors, tools and equipment. Also separate catalog on Class ES heavy-duty compressor.

Blowers. Roots-Connersville-Wilbraham, Connersville, Ind. Bulletin 21-B16, Victor-Acme blowers. Pp. 4.

Conveyors. Jeffrey Manufacturing Co., Columbus, Ohio. Bulletin 569. Belt idlers. Pp. 12.

Compressors. Atlas Diesel Co., Ltd., London, England. Bulletin K.A. 35, describing Type C4DKV Atlas portable diesel-engine driven air compressors.

Excavators. Ruston-Bucyrus, Ltd., Lincoln, England. Publication RB1177, 33 pp., illustrating and describing characteristics and scope of No. 4 Universal $\frac{1}{2}$-yd. excavator, for dragline, skimmer, shovel, crabbing-crane, crane, or drag-shovel operations.

Daily and Average Monthly Prices of Metals

August, 1933

United States Market

Aug.	Electrolytic Copper—Domestic	Electrolytic Copper—Export	Straits Tin—New York	Lead—New York	Lead—St. Louis	Zinc—St. Louis
1	8.775	8.025	44.200	4.50	4.35	5.00
2	8.775	7.975	44.750	4.50	4.35	5.00
3	8.775	8.200	45.000	4.50	4.35	5.00
4	8.775	8.125	44.850	4.50	4.35	5.00
5	8.775	8.125	44.800	4.50	4.35	5.00
7	8.775	8.125	44.600	4.50	4.35	5.00
8	8.775	8.050	44.650	4.50	4.35	5.00
9	8.775	8.050	44.750	4.50	4.35	5.00
10	8.775	8.025	44.750	4.50	4.35	5.00
11	8.775	8.000	44.650	4.50	4.35	5.00
12	8.775	7.975	44.400	4.50	4.35	5.00
14	8.775	7.950	44.125	4.50	4.35	5.00
15	8.775	7.725	43.675	4.50	4.35	5.00
16	8.525@8.775	7.725	43.500	4.50	4.35	5.00
17	8.775	7.625	44.500	4.50	4.35	5.00
18	8.775	7.850	44.750	4.50	4.35	4.875@4.950
19	8.775	7.850	44.625	4.50	4.35	4.90
21	8.775	7.825	44.500	4.50	4.35	4.850@4.900
22	8.775	7.825	44.125	4.50	4.35	4.850
23	8.775	7.775	44.625	4.50	4.35	4.850
24	8.650@8.775	7.825	44.750	4.50	4.35	4.800
25	8.775	7.875	46.000	4.50	4.35	4.775@4.850
26	8.775	7.975	46.125	4.50	4.35	4.800
28	8.775	7.950	45.375	4.50	4.35	4.750
29	8.775	8.000	46.000	4.50	4.35	4.750
30	8.775	7.975	45.625	4.50	4.35	4.700@4.750
31	8.775	7.875	45.750	4.50	4.35	4.700
Av. for month	8.768	7.937	44.794	4.50	4.35	4.916
			Averages for Week			
2	8.765	8.150	44.825	4.50	4.35	5.00
9	8.775	8.113	44.775	4.50	4.35	5.00
16	8.754	7.900	44.183	4.50	4.35	5.00
23	8.775	7.792	44.521	4.50	4.35	4.898
30	8.765	7.933	45.646	4.50	4.35	4.773
			Calendar Week Averages			
5	8.775	8.113	44.725	4.50	4.35	5.00
12	8.775	8.038	44.633	4.50	4.35	5.00
19	8.754	7.788	44.196	4.50	4.35	4.969
26	8.765	7.850	45.021	4.50	4.35	4.831

Silver, Gold, and Sterling Exchange New York and London

Aug.	Sterling Exchange—"Checks"	Sterling Exchange—90-Day "Demand"	Silver—New York	Silver—London	Gold—London
1	4.4200	4.4400	35.3750	17.8750	124s
2	4.4600	4.4800	35.5000	17.7500	124s 3 d
3	4.5300	4.5500	36.0000	17.8750	124s 7 d
4	4.4950	4.5150	35.8750	17.8750	124s 6½d
5	4.4950	4.5150	35.8750	17.8750	124s 9 d
7	4.4800	4.5025	35.8750	Holiday	Holiday
8	4.4850	4.5050	36.0000	17.9375	124s 7½d
9	4.4850	4.5050	36.1250	17.9375	124s 8 d
10	4.4875	4.5075	36.3750	18.0625	124s 8 d
11	4.4900	4.5100	36.1250	17.9375	124s 8½d
12	4.4800	4.5000	35.7500	17.8750	124s 8½d
14	4.4550	4.4750	35.6250	17.8125	124s 8 d
15	4.4200	4.4400	35.3750	17.7500	124s 10d
16	4.4075	4.4300	35.0000	17.7500	125s 3 d
17	4.4200	4.4400	35.3750	17.7500	125s 3 d
18	4.5300	4.5450	36.3750	17.8750	125s ...
19	4.4900	4.5150	35.8750	17.8125	125s ...
21	4.5000	4.5250	36.1250	17.8125	125s 2 d
22	4.4950	4.5200	36.0000	17.8125	125s 3 d
23	4.5300	4.5525	36.5000	17.9375	125s 5 d
24	4.5650	4.5825	36.6250	17.8750	125s 9 d
25	4.5900	4.6150	36.8750	17.7500	126s 2 d
26	4.6300	4.6475	37.0000	17.9375	129s 4 d
28	4.5425	4.5725	36.5000	17.8125	128s 8½d
29	4.5450	4.5625	36.6250	18.0000	129s 4½d
30	4.5350	4.5550	36.6250	18.1250	128s 9½d
31	4.5225	4.5400	36.6250	18.0000	129s 7 d
Av. for month	4.49944	.....	36.074	17.877	.....
			Averages for Week		
3	4.50083	.....	35.875	.....	.....
9	4.49500	.....	35.958	.....	.....
16	4.45667	.....	35.708	.....	.....
23	4.49467	.....	36.042	.....	.....
30	4.56792	.....	36.708	.....	.....

Calendar week averages: New York Silver Aug. 5, 35.708; Aug. 12, 36.042; Aug. 19, 35.604; Aug. 26, 36.521.

London Market

Aug.	Copper—Standard—Spot	Copper—Standard—3 Mo.	Copper—Electrolytic Bid	Tin—Spot	Tin—3 Mo.	Lead—Spot	Lead—3 Mo.	Zinc—Spot	Zinc—3 Mo.
1	35.9375	36.0625	41.0000	212.3750	213.0000	12.2500	12.5000	16.5625	16.8125
2	36.4375	36.6250	41.0000	214.2500	214.6250	12.4375	12.6875	16.6875	17.0000
3	36.6875	36.9375	41.0000	214.5000	214.8750	12.6250	12.8750	16.8125	17.1875
4	36.8125	37.0000	41.0000	214.7500	214.8750	12.3750	12.7500	16.7500	17.0625
8	36.5625	36.8125	41.0000	214.5000	214.6250	12.1250	12.4375	16.5000	16.8125
9	36.6250	36.8125	41.0000	215.3750	215.3750	12.2500	12.6250	16.7500	17.0000
10	36.7500	37.0000	41.0000	216.2500	216.2500	12.3125	12.6875	16.8750	17.1875
11	36.6875	36.9375	41.0000	215.7500	215.7500	12.2500	12.6875	16.8750	17.1250
14	36.1250	36.3750	40.2500	215.3750	215.0000	12.1250	12.5000	16.6875	16.8125
15	35.7500	36.0000	40.2500	214.5000	214.0000	12.0625	12.3750	16.7500	16.8750
16	36.0000	36.1875	40.2500	214.8750	214.6250	12.0000	12.3125	16.8125	17.0000
17	35.3750	35.5625	39.5000	213.2500	213.2500	11.7500	12.0625	16.6250	16.8125
18	36.1250	36.3125	40.2500	215.3750	215.2500	12.0625	12.3750	17.0000	17.1250
21	35.6250	35.8750	40.2500	213.0000	213.0000	11.9375	12.2500	16.7500	16.8125
22	35.6250	35.8750	39.7500	213.1250	213.2500	11.8750	12.1875	16.8125	16.8125
23	35.5625	35.7500	39.5000	213.1250	213.0000	11.8750	12.1250	16.8125	16.8125
24	35.1875	35.3750	39.0000	213.3750	213.0000	11.8750	12.1250	16.8125	16.8125
25	35.5625	35.8125	39.2500	214.5000	214.2500	12.1250	12.3125	16.8750	16.9375
28	35.8750	36.1250	39.7500	217.0000	216.8750	12.1875	12.4375	17.0625	17.1250
29	36.1250	36.3750	39.7500	219.8750	219.7500	12.4375	12.5625	17.3750	17.5000
30	36.0625	36.3125	39.7500	219.3750	219.3750	12.5000	12.5625	17.5000	17.5625
31	36.0625	36.3125	39.5000	220.1250	220.0000	12.5625	12.6250	17.4375	17.5000
Av. for month	36.071	.....	40.227	215.210	.....	12.182	12.457	16.869	17.031

The United States quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices of domestic class are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.37c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West are based on a minimum

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1932	1933	1932	1933	1932	1933
January	29.780	25.400	19.623	16.883	342.515	336.060
February	30.136	26.074	19.573	16.885	345.141	342.114
March	29.810	27.928	18.336	17.588	363.463	343.138
April	28.298	30.730	16.923	18.440	374.731	357.565
May	27.755	34.072	16.868	19.046	367.370	393.106
June	27.466	35.663	16.844	19.078	364.471	413.216
July	26.700	37.630	16.930	18.341	354.865	464.760
August	27.986	36.074	18.000	17.877	347.449	449.944
September	27.870	.....	17.998	.....	347.003	.....
October	27.195	.....	17.813	.....	339.500	.....
November	26.698	.....	18.099	.....	327.458	.....
December	25.010	.....	17.110	.....	327.683	.....
Year	27.892	.....	17.843	.....	350.137	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery			London Spot			
	Electrolytic			Standard		Electrolytic	
	Domestic		Export				
	1932	1933	1933	1932	1933	1932	1933
January	7.060	4.775	4.741	39.459	28.557	46.200	33.244
February	5.965	4.775	4.710	36.917	28.481	41.381	32.556
March	5.763	5.011	4.779	33.039	28.179	36.786	32.370
April	5.565	5.395	5.185	29.943	29.576	34.190	33.681
May	5.237	6.698	6.569	28.548	34.071	32.833	38.163
June	5.145	7.773	7.484	26.872	36.759	30.841	41.000
July	5.053	8.635	8.446	26.071	37.917	29.107	41.571
August	5.219	8.768	7.937	31.401	36.071	34.784	40.227
September	5.978	.....	.....	34.986	.....	38.318	.....
October	5.733	.....	.....	31.890	.....	36.190	.....
November	5.131	.....	.....	31.972	.....	36.568	.....
December	4.813	.....	.....	29.088	.....	34.344	.....
Year	5.555	.....	.....	31.682	.....	35.962	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1932	1933	1932	1933	1932 Spot	1932 3 Mos.	1933 Spot	1933 3 Mos.
January	3.750	3.000	3.550	2.875	15.084	15.128	10.458	10.833
February	3.712	3.000	3.499	2.875	14.560	14.571	10.431	10.719
March	3.150	3.146	2.993	3.021	12.345	12.634	10.609	10.821
April	3.000	3.260	2.900	3.135	11.223	11.503	10.872	11.122
May	3.000	3.654	2.900	3.525	10.673	11.036	12.095	12.372
June	2.993	4.173	2.896	4.023	9.608	9.898	13.280	13.571
July	2.747	4.452	2.611	4.303	9.818	10.152	13.411	13.613
August	3.235	4.500	3.093	4.350	11.349	11.588	12.182	12.457
September	3.465	.....	3.315	.....	13.122	13.349	.....	.....
October	3.052	.....	2.939	.....	11.958	12.170	.....	.....
November	3.050	.....	2.931	.....	12.071	12.395	.....	.....
December	3.000	.....	2.877	.....	11.144	11.541	.....	.....
Year	3.180	.....	3.042	.....	11.913	12.164	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1932	1933	1932	1933
	Straits		Standard, Spot	
January	21.804	22.692	140.219	145.708
February	22.018	23.500	139.143	148.544
March	21.863	24.221	129.810	149.120
April	19.244	27.136	108.935	157.944
May	20.948	36.051	122.286	186.207
June	19.659	44.097	114.530	219.964
July	20.931	46.356	125.863	216.673
August	22.985	44.794	142.017	215.210
September	24.779	.....	152.705	.....
October	23.936	.....	151.280	.....
November	23.354	.....	153.585	.....
December	22.677	.....	149.806	.....
Year	22.017	.....	135.848	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1932	1933	1932 Spot	1932 3 Mos.	1933 Spot	1933 3 Mos.
January	3.011	3.018	14.416	14.834	14.381	14.595
February	2.817	2.666	13.872	14.289	13.866	14.119
March	2.787	2.987	12.616	13.024	14.647	14.674
April	2.725	3.298	11.670	11.958	14.951	15.208
May	2.532	3.805	12.432	12.682	15.505	15.660
June	2.777	4.348	11.548	11.866	16.988	16.774
July	2.537	4.878	11.592	11.967	17.795	17.789
August	2.758	4.916	13.594	13.844	16.869	17.031
September	3.322	.....	15.455	15.616	.....	.....
October	3.027	.....	14.869	15.140	.....	.....
November	3.094	.....	15.264	15.534	.....	.....
December	3.124	.....	15.209	15.347	.....	.....
Year	2.876	.....	13.545	13.842	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1932	1933	1932	1933
January	55.000	55.000	23.300	23.300
February	55.000	55.000	23.300	23.300
March	55.000	55.000	23.300	23.300
April	55.000	55.000	23.300	23.300
May	55.000	55.000	23.300	23.300
June	55.000	55.000	23.300	23.300
July	55.000	55.000	23.300	23.300
August	55.000	55.000	23.300	23.300
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1932	1933	1932	1933	1932	1933
January	5.976	5.722	64.900	48.500	40.000	26.480
February	6.489	5.738	66.304	48.614	40.000	24.000
March	6.188	5.901	72.537	52.676	40.000	24.667
April	5.746	5.876	72.125	54.580	40.000	26.800
May	5.170	6.264	66.380	56.500	39.500	28.500
June	5.034	6.500	59.481	60.038	37.500	30.000
July	5.000	7.262	53.580	62.900	35.200	32.320
August	5.144	6.986	47.444	63.500	35.000	33.000
September	5.606	.....	47.500	.....	33.800	.....
October	5.575	.....	47.600	.....	33.000	.....
November	5.771	.....	48.750	.....	33.000	.....
December	5.400	.....	48.500	.....	30.462	.....
Year	5.592	.....	57.925	.....	36.455	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1932	1933	1932	1933	1932	1933
January	16.00	14.50	15.00	14.00	15.50	14.50
February	15.68	14.50	14.68	14.00	15.18	14.50
March	15.50	14.50	14.50	14.00	15.00	14.50
April	15.50	14.50	14.50	14.00	15.00	14.50
May	15.50	15.42	14.50	14.42	15.00	14.92
June	14.85	16.00	14.35	15.00	14.75	15.50
July	14.56	16.50	14.00	15.50	14.50	16.00
August	14.50	17.00	14.00	16.00	14.50	16.50
September	14.50	.....	14.00	.....	14.50	.....
October	14.50	.....	14.00	.....	14.50	.....
November	14.50	.....	14.00	.....	14.50	.....
December	14.50	.....	14.00	.....	14.50	.....
Year	15.01	.....	14.29	.....	14.79	.....

Iron in dollars per long ton freight to Pittsburgh, $1.89. F.o.b. Mahoning and Shenango Valley furnaces.

price basis of 4½c. per pound.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

New York silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, 925 fine. Sterling prices represent noon market demand.